473
Sci 73

REGD. NO. M. 2799.

SUPPLEMENT: INDIAN SCIENCE CONGRESS, 1937.

Current Science

No. 7 (Pp. 347-406) JANUARY 1937 Vol. V

4
18
7

CURRENT SCIENCE

Vol. V] January 1937 [No. 7

The Indian Institute of Science—I.

We have read the report of the Second Quinquennial Reviewing Committee on the working of the Indian Institute of Science, and we congratulate the members on the remarkable celerity with which they have accomplished their task. We agree with the statement that the circumstances, under which the Committee assembled for commencing their labours, were not propitious, and the atmosphere of the Institute was impregnated with passion and prejudice arising from a clash of ideals. It is almost superhuman to escape being influenced by the prevailing public feeling, and we consider that the ardent observations expressed by the Committee in certain sections of the report can be traced to such influence.

It will be remembered that the practice of appointing periodical committees for reviewing the work of the Institute owes its origin to the recommendation of the Pope Committee which set forth this purpose in the following terms:

> "The progress of a young institution of a character entirely new to India calls for the continual interest of those responsible for its development, not necessarily for purposes of criticism, but rather in order to determine in what ways its usefulness to the community may be extended."

We have now before us the reports of the three Committees, which after a careful and critical examination of the original intention of the Founder have provided us with comprehensive criticisms of the working of the Institute and with equally comprehensive recommendations for its improvement. The Committees differ regarding the interpretation of the aims and objects outlined in the scheme for the administration of the Institute and accordingly their recommendations diverge. It seems to us that the period of five years prescribed for the appointment of the Reviewing Committees is too short a term for the Institute to produce appreciable results, based on the recommendations of their predecessors, and frequently the authorities of the Institute

are bewildered by the conflicting reports and recommendations coming in quick succession, and reducing this great organisation to a state of perpetual transition. If the reports of all these three Committees are carefully perused, one cannot fail to discover that each of them has honestly endeavoured to pull the Institute inside out, and then laboriously to reconstruct a fresh model on the personal predilections of the members. In none of these reports could we discover an account of how far the recommendations of the previous Committee have been adopted by the Institute and with what results, but on the other hand the Committees have proceeded to their task as if they were the first body investigating into the working of the Institute. What is most surprising is that neither the Government of India, nor the Council of the Institute are embarrassed by the periodical revision of the aims and objects of the Founder, and by the multitude of conflicting recommendations for their speedier and better achievement.

In view of the far-reaching importance of the recommendations made by the Irvine Committee, which in certain respects appear to us impractical, we are definitely of opinion that the Institute should have reasonably long period of time to give them a fair and honest trial, without being encumbered by a further instalment of fresh recommendations by another Quinquennial Reviewing Committee. If in writing their report the Irvine Committee had reviewed the progress of scientific investigations in the official and non-official centres of research, as was done by the Pope Committee, we are convinced that their proposals of reorganisation would have assumed a different complexion. The want of this necessary background,—whose importance in the enquiry of the character such as the Committee had undertaken to investigate, few will be disposed to dispute,—has invested their suggested arrangements with an air of unreality. It is pointed out in more than one section of the report that the Institute should co-ordinate with other centres of research, both in the theoretical and applied branches of science, and the general reader of this document can obtain no information regarding the state of development reached by these institutions, without which he may presumably form no conception of the nature and extent to which any co-operation can profitably be established.

Dealing with the aims and objects of the Indian Institute of Science, a subject which has been critically and carefully examined by two previous Committees which had formulated the policy in clear and unambiguous language, the Irvine Committee report that

> "it is more than ever necessary to secure that the policy pursued is consistent with the wishes of the Founder and of the contributing bodies,"

and proceed to observe that

> "the province and purpose of the Institute must be defined in more precise terms than at present, and that such a definition should be adopted officially by the Council of the Institute and the Government of India. Only in this way can the aims and objects of the Institute be placed beyond individual and fluctuating interpretations; in the absence of such definition, no continuous policy can be developed."

If these sentences are intended to imply that the Institute has been working for the past twenty-five years and more without any specific aim and without ambition to achieve any definite object and without regard to the intentions of the Great Benefactor, we are afraid that the Irvine Committee will find neither the Council nor the Government sharing their sentiment. Reviewing the activities of the Institute for over twenty-five years,* Alchymist indicated their underlying policy in these terms:

> "Higher authorities concerned in establishing the Institute were very definite on this point, however, as appears from a resolution by the Government of India in this matter dated 27th May 1909. During the discussion then prevailing Government were of opinion that the idea of combining in one Institution and entrusting to a single staff of professors both the teaching of science and the experimental development of new industries, was open to the obvious criticism that these two objects were in no way connected together." Moreover the two educational experts (Professor Masson and Principal Clibborn) finally deputed to frame a scheme recommended, "that the Institute should be devoted to experimental science, and should aim at training students in experimental methods, carrying on original research and discharging the functions of an accepted authority and referee on all scientific problems within its own domain.
>
> "Finally the Vesting order founds 'an Institute of research in India' and the attached scheme of administration inculcates 'the promotion of original investigations in all branches of knowledge and their utilisation for the benefit of India' without specific mention of industrial activities."

In reviewing this official policy which continued to be the basis of the entire range of

---

* *Curr. Sci.*, Octr. 1932, p. 91.

activities of the Institute till 1921, the Pope Committee observed that

"the Founder of the Institute, the late Mr. J. N. Tata, desired to establish an Institute of Research; so far as our information goes he introduced no limiting clauses in connection with his benefaction, but it is probably beyond dispute that he desired to build and endow an institution which would provide Indian students with such facilities for work and training as would enable India to compete on equal terms with other countries as a producer of new knowledge and that he wished his Institute to aid Indian students to serve India in Science and Technology. It cannot be doubted that, under the conditions briefly stated above, the objects which the Founder had in mind will be best served by the provision of preliminary training in scientific methods and knowledge, supplementary to more Elementary Scientific education, for the purpose of preparing selected individuals for careers based upon original work in either pure science or technology."

In further examining the aims and objects of the Institute, the Sewell Committee wrote that

"while agreeing with the resolution of the Pope Committee that 'it is undesirable that the activities of the Institute, in connection with teaching and research, should be confined to matters which bear on the application of science to industry,' we are of opinion that in the future more attention should be paid to those lines of research that have or may have a direct bearing on the existing industries of India or that may be expected to open up fresh industries at present undeveloped in this country."

The Irvine Committee observe that

"neither of these reports challenges the view that the Founder desired to encourage industry and this remains the primary function of the Institute."

"In coming to the above conclusion it is far from our intention to deprecate academic research. We are fully alive to the advantages and the cultural and material benefits which accrue from fundamental scientific work; equally we recognise that there is no conflict between pure and applied research which can be and ought to be, prosecuted side by side to their mutual advantage. We are chiefly concerned with the problem as to which of these complementary activities should carry the greater emphasis and we hold strongly the opinion that, in accordance with the wishes of the Founder, this emphasis should be laid on the application of scientific research to industry."

These views are obviously opposed to the resolution of the Government of India and to the opinions of the educational authorities deputed to frame a working scheme thereunder. The Pope and Sewell Committees did not exalt industrial research to the position of pre-eminence, subordinating academical enquiries. The fluctuations in the interpretation of the fundamental intention of the Founder were not the making of individuals, but are entirely due to the personal predilections of the Committees. The Irvine Committee were led to formulate their views expressed in their amendment to Clause 3 in the Regulations chiefly because in their opinion the phrase "the benefit of India" occurring in the Scheme of Administration, implies "that the activities of the Institute should be devoted primarily to securing for India the material benefits expected to follow from the close association of the scientific research with the industries of the country". This is only partly true, for the scheme of administration comprehends something more fundamental than material prosperity, for it specifies,

"That the object of the Institute shall be to establish Chairs and Lectureships in Science and Arts, especially with a view to the promotion of original investigation in all branches of knowledge and their utilisation for the benefit of India."

If, however, the Irvine Committee had considered in their report the progress of work achieved in other institutions specially equipped and organised by the Provincial and Central Governments to investigate material and cognate problems, they would have expressed their views regarding the aims and objects of the Institute in more restrained terms. Besides in formulating the scientific policy of a Foundation which has carried on its activities for over 25 years on the basis of the resolution of the Government of India at the time of its inception, the Committee should have taken into consideration the geographical position of the Institute, its existing equipment and organisation, the training, knowledge and capacity of the members of the staff to give practical effect to the new proposal.

We shall now proceed briefly to deal with some of the specific recommendations of the Committee. In their suggestions respecting the correlation of research work conducted in the Institute with the industrial needs of India, they observe

"That it is essential to relieve the staff of the sole responsibility for finding industrial problems for investigation. These problems should be submitted to the Institute by some responsible body capable of collecting proposals from India as a whole and of sifting them so as to exclude merely routine enquiries and suggestions which are too unwieldy to be handled by the comparatively small number of workers available at Bangalore. The initiation of problems might well be undertaken by such bodies as (1) The Industrial Intelligence and Research Bureau,

(2) The Imperial Council of Agricultural Research and (3) Departments of Industries."

Writing on the claims of External Bodies on services of staff, the Pope Committee wrote as follows :

" It will be at once obvious that if outside bodies or persons including governments and administrations, exercise any claim upon the professional services of the professorial staff of the Institute, grave difficulties will immediately arise connected with what may be termed the regular work of the staff, namely, the training of students and the prosecution and direction of research work. In a country like India, which is doubtless on the eve of great developments in its natural resources and which does not as yet command in its industries the services of technologists in all the branches of scientific industry which will be established in the near future, it is conceivable that the interest of the country may be best served by utilising for specific investigations the services of one or other members of the staff of the Institute. We are, however, of opinion that unless imperative necessity demands, it is undesirable that the members of the staff of the Institute should be drafted way to deal with outside problems which may present themselves to Indian governments and administrations."

It is obvious that a research institution of the magnitude and importance of the Indian Institute of Science should be permitted to enjoy complete scientific autonomy within its own domain, and any attempt to restrict its freedom may result in the defeat of the very object which the Irvine Committee are so genuinely eager to promote. During its fairly long history, the Institute has established certain traditions, and reform in the desired direction must proceed on lines of least resistance. The transformation of the Institute into a centre of industrial research, so as to secure the material welfare of India, can take place, provided it is re-equipped and re-staffed and the external agents continue to supply a steady stream of problems.

In their recommendations to make applied research the first and most responsible duty of the Institute, the Irvine Committee suggest that "the active prosecution of applied research should be regarded as a duty, willingly undertaken with the certain knowledge that the more energetically this duty is fulfilled, the less scientific prominence becomes attached to the workers themselves. Few publications are likely to result from such research work, but this need not be deplored if in the end the Institute is made to play the part for which it was created." Assuming that the Institute was brought into being solely for the purpose of promoting industrial research, it is conceivable how far the ideal of self-efacement advocated by the Committee will attract scientists of eminence to the work outlined in the scheme. Most scientific men are, generally sreaking, regardless of the worldly goods, and as a compensation they naturally look for the recognition of their work by the learned societies, whose distinctions are, however, awarded absolutely on the basis of published records. Suppose there is a fall in the number of papers, will the professors of the Institute have the assurance that they are immune to the criticisms of the next reviewing committee for such paucity.

Commenting on the financial position of the Institute, the Committee observe that "income no longer balances the normal recurring expenditure, and it has become necessary to draw on the accumulated reserves in order to meet the annual deficit." In Part II of the report the figures for income and expenditure for seven years are given in a tabular form, and we calculate that the total revenue for this period amounted to Rs. 40,03,678 and the recurring expenditure for this period amounted to Rs. 37,95,735. The income did balance "the normal recurring expenditure". During this period, however, the Institute spent Rs. 5,18,549 under the head "non-recurring expenditure", which manifestly utilised in the extension of existing buildings, or the addition of new ones, or in the purchase of costly apparatus, must be of permanent value as additional investment. If the accumulated reserves have been partly used up for this purpose, the authorities of the Institute had the support of the Sewell Committees which wrote that "the opening balance in each case includes funds held in suspense for retiring allowances and depreciation ; the portion of the opening balance now available for ordinary expenditure is Rs. 6·55 lakhs. Although in some undertakings such figures would indicate a most satisfactory state of affairs we view with some apprehension the accumulation of funds to this extent in an institution which is purely educational. It is open to question whether this accumulation of funds is justified when the Institute is in receipt of substantial grants from some of the Provincial and State Governments."

We propose to deal with the remaining sections of the report in our next issue.

Geographical Distribution of Indian Freshwater Fishes and Its Bearing on the Probable Land Connections between India and the Adjacent Countries.*

By Sunder Lal Hora, D.Sc., F.R.S.E., F.N.I.
(*Assistant Superintendent, Zoological Survey of India, Calcutta.*)

THE relationships and the geographical distribution of the freshwater fishes of India were discussed by two of the leading ichthyologists, Day[3,4]† and Günther[7], of the last century. The former advocated Malayan affinities for the Indian fauna, while the latter, though admitting the migration of several Oriental freshwater fishes to Africa, laid special stress on the African affinities of this fauna. Beyond some casual references[1,2] very little work has since been done on this aspect of the Indian freshwater fishes, and in view of the advances that have been made in our knowledge of the paleogeography and systematics of fishes it seems opportune to review the whole subject in the light of recently discovered facts.

A freshwater fish lives entirely in freshwater, both in the young and adult stages, and never descends to the sea. The above definition excludes all anadromous fishes which are essentially marine but ascend freshwaters for breeding, and the catadromous fishes which are essentially freshwater forms but descend into the sea for similar purposes. As the freshwater fishes are generally restricted to the water courses in which they live, they form a very important group for the elucidation of the paleohydrographical relationships of adjacent lands. Watersheds in the case of these fishes form effective barriers so long as their positions remain unchanged; the process of river-capture, however, may facilitate their migration in one direction but not in the other. There is an unfortunate impression, mainly among geologists, that in the case of fishes dispersal may be effected through the agency of birds, chiefly aquatic species, which may carry the eggs attached to their feet from one watershed to another. Those, who have paid particular attention to this matter, however, are definitely of the opinion that such a mode of dispersal of freshwater fishes is normally highly improbable, even though there may be records of such fortuitous dispersal in practically all groups of animals including freshwater fishes.

In connection with my work on the Siluroid fishes of India for a revised edition of "Fishes" in the *Fauna of British India* series, I have been greatly struck by the close similarity of the Indian forms to those found towards the east in Indo-China, Siam, and the Malay Archipelago. As a result of a detailed study of the genera and species inhabiting these regions I am definitely of the opinion that the freshwater fish fauna of India in the main originated in South-eastern Asia, most probably in Indo-China, and spread westwards by successive waves of migration to India and later to Africa while the two masses of land were connected with each other. Gregory's researches[5,6] on the evolution of the mountain and river systems of South-eastern Asia have shown that in this region there were extensive river captures—the rivers on the west beheading the rivers on the east; these changes made possible the migrations of aquatic animals from the east to the west but not in the reverse direction. Gregory's researches have further shown that all the rivers of Eastern Tibet drained into the Gulf of Siam or the South China Sea before the present river systems became established, and this bears out Pelseneer's view.[12,13] The freshwater fauna of Eastern Asia at least may have originated along the coasts of Indo-China, when the ocean water in this area was greatly diluted by the drainage into it of several river systems.

Professor Gregory's views about the capture of the eastern rivers by the western rivers are, however, not accepted by all geologists, for there is a general belief that the Brahmaputra and the Irrawaddy-Salween systems were separated in the Pre-Eocene period by the Tethys Sea and in the Post-Eocene days by the newly upheaved Himalayas, the

---

* Summary of the remarks made at the Hyderabad meeting of the Indian Science Congress during a joint discussion between the Sections of Geology, Botany and Zoology on Wegener's theory of Continental Drift with special reference to India and the adjacent countries, and published with permission of the Director, Zoological Survey of India.

† Numerals refer to the corresponding numbers in the list of references at the end of the article.

Patkoi Range and the Arakan Yomas. According to these views there could not be any migration of freshwater faunas by a system of river-captures, except perhaps during the transition periods, between the Indo-Chinese rivers and the Indian rivers. Further there is no geological evidence for the Indian rivers having originated in Burma. Some of the peculiarities in the distribution of Indian freshwater fishes may be explained on the supposed existence of the Siwalik or the Indo-Brahm River,[11,14,18] but a considerable mass of evidence bearing on the close relationship and distribution of the fishes of South-eastern Asia demands for its explanation a hypothesis similar to that worked out by Gregory. This mass of evidence is so striking and convincing that it may be worth-while for the geologists to re-examine their data regarding the Cretaceous-Tertiary land connections between India and the Far East.

Mori[10] has recently stressed the Oriental affinities of the fish-fauna of the Upper Yangtse-Kiang which comprises an abundance of the Siluroidea, the Homalopteridæ, the Ophicephalidæ and a large number of Indian genera of the Cyprinidæ. These results fully support Gregory's work according to which the Upper Yangtse-Kiang at first drained into the Red River but later turned northeastwards across Central China to the East China Sea. Only such a course of events could account for the presence of Oriental genera in the Upper Yangtse-Kiang and the Palæarctic genera in its middle and lower portions. According to Mori's researches the Nan Shan Mountain Range divides China into the northern Palæarctic subregion and the southern Oriental subregion.

As a comprehensive example of the east to west migration of the aquatic fauna, one may consider the evolution and distribution of the family Schilbeidæ* which is represented both in the Oriental and the Ethiopian regions by a number of genera. Of the 19 or 20 genera of the family that can be recognised at the present day there is not one that is common to the two regions. If it be conceded that the ancestors of the Schilbeidæ were devoid of barbels and teeth in the jaws, it naturally follows that the African genera, usually with eight barbels and a well-developed dentition, represent a fairly specialised and more highly evolved branch of the family; African genera such as *Ansorgia* Boulenger, with only one pair of mandibular barbels, and *Siluranodon* Bleeker, with no teeth in the jaws, are retrogressive forms as compared with the primitive genera found in the Far East. I believe that *Pangasianodon* Chevey, represents the least specialised form of the family; this genus is found in Indo-China and is characterised by the possession of two minute maxillary barbels, a large air-bladder and no teeth. *Silonia* Swainson, of the Indian waters, also possesses two minute barbels, but owing to its highly predaceous habits, it has developed large caniniform teeth both in the jaws and on the palate. Due to the reduction of its body cavity by the greater development of the caudal region and the lateral compression of the body the air-bladder is greatly reduced. In Peninsular India some less specialised, *Silonia*-like fishes became further modified and developed two additional mandibular barbels; they possess caniniform teeth and a long anal fin but the air-bladder is not so greatly reduced as in *Silonia*. For this new type I have proposed the name *Silonopangasius*.† So far as can be judged at present this line of specialisation only extended as far as the extreme west of Peninsular India.

Pangasianodon-like ancestors also gave rise to forms like *Helicophagus* Bleeker and *Pangasius* Cuvier and Valenciennes; the latter is found from Indo-China to India, while the former, in which the dentition is only partially developed, is found only in the Far East and is absent from Burma and India. Though there are several species of *Pangasius* in Indo-China, Siam and the Malay Archipelago, in Indian waters it is represented by a single, very highly specialised form. Here again the specialisation in form occurs as one proceeds from the east to the west.

In Siam and the Malay Archipelago *Helicophagus* gave rise to the genus *Laides* Jordan (= *Lais*, 6 barbels); possibly *Laides* evolved into *Pseudeutropius* Bleeker (8 barbels) in the Malay Archipelago; the latter genus is also found in India. Certain members of *Pangasius*, probably more specialised as regards dentition, gave rise in

* For a detailed treatment of the classification, distribution, ecology and evolution of the Schilbeidæ reference may be made to my paper, shortly to be published in the *Records of the Indian Museum.*

† Genotype: *Ageneiosus childreni* Sykes, 1841.

Siam to *Platytropius*,* a new genus with extensive patches of vomero-palatine teeth, and with a flattened head and air-bladder, and in India to *Proeutropiichthys*,† a new genus for species of *Pseudeutropius* with four patches of teeth on the palate. In the Indian waters *Pseudeutropius* gave rise to *Ailia* Gray and *Proeutropiichthys* to *Eutropiichthys* Bleeker, the latter genus is also known from Siam. Probably *Platytropius* gave rise to *Clupisoma* Swainson of the Indian Waters. From the primitive stock that gave rise to *Proeutropiichthys*, probably developed all the Schilbeid genera of Africa, at a stage when the mandibular barbels were considerably behind the tip of the lower jaw and were not situated in a straight line. So far no intermediate forms have been discovered between the Indian *Pseudeutropius* (*sensu lato*) and the African *Eutropius*. As the difference in the two forms consists mainly in the position of the mandibular barbels, no palæontological records will ever be able to bridge the gulf between the Indian and the African Schilbeidæ. There is, however, little doubt about the close genetic affinities of the Indian and the African genera of the Schilbeidæ.

According to Regan[16] "The distinctness of the African and the Indian Schilbeidæ makes it probable that this family was established in both regions in pre-tertiary times." The probable history of the dispersal of the Schilbeidæ as understood by me makes it clear that this family must have extended its range to Africa before the two continents became disconnected, probably during or after the Eocene.

The facts detailed above concerning the geographical distribution of the Schilbeidæ are opposed to the theory of permanence of oceans and continents, as they can only be explained by the existence of connected water courses, through either river-captures, commingling or otherwise, over a land connection between India and Africa. Whether this connection was in the form of a "land-bridge" between the two continents, or the two land-masses were merely juxtaposed at some remote period and later drifted apart, it is very difficult to decide. It seems clear, however, that even during the Eocene South India and Africa had land-connections which permitted a dispersal of the freshwater fishes from the former to the latter country. The abrupt change in the African and the Indian Schilbeidæ is certainly the result of some form of isolation since a fairly remote period, and before this occurred presumably the Indian forms were of the same type as those now found in Africa. The higher specialisation of the Indian genera can be accounted for by the fact that India was a centre of great disturbance during the Tertiary period owing to the earth-movements that gave rise to the Himalayas, whereas Tropical Africa with its large lakes provided a stable environment for its fauna and the specialisations of the Schilbeidæ of this region can definitely be correlated with life in comparatively calm and clear waters.

There is also a belief that the Ostariophysi, the class to which Catfishes and Carps belong, originated in the north and spread southward to different continents. This hypothesis would explain the occurrence of allied genera both in India and Africa without the aid of a land connection between the two countries. Regan[16] has already pointed out that this view "involves so many improbabilities as to be almost unbelievable." The mode of dispersal of the Schilbeidæ as detailed above is strongly opposed to the northern origin of the Ostariophysi and appears to be entirely in accord with the recent geological work on the river and mountain systems of South-eastern Asia.

While discussing the African element in the freshwater fauna of India Annandale[2] remarked: "Doubtless the three territories (*i.e.*, Africa, S. America and India) had then a very similar freshwater fauna, but there is some evidence that Africa was its centre of distribution." Unfortunately he made no reference to this evidence, and in view of what is stated above it seems almost impossible to believe that the freshwater fauna of India was at any stage, at least during the Tertiaries, invaded by that of Africa.

Prashad[15] from his study of the recent and fossil Viviparidæ (Mollusca: Gastropoda) came to the conclusion that "Peninsular India forms the central zone whence the Viviparids of Asia and Africa are derived." At the present day, so far as freshwater fishes are concerned, Peninsular India contains many primitive forms, and thus

* Genotype: *Pseudeutropius siamensis* Sauvage, 1883.

† Genotype: *Eutropius macrophthalmus* Blyth, 1860.

superficially it may appear to be a centre of origin of the common Indo-African fauna, but the taxonomic and paleogeographical evidences adduced above show that the freshwater fish-fauna of Peninsular India was itself derived from that of South-eastern Asia.

The close relationship between certain highly peculiar genera of Indo-China and India, such as *Carpiocatla* Boulenger, and *Catla* Cuvier and Valenciennes; *Parapseudecheneis* Hora and *Pseudecheneis* Blyth, *Gyrinocheilus* Vaillant and *Psilorhynchus* McClelland; etc., etc., and the distribution of *Silurus* Linnæus and the Homalopteridæ also prove conclusively that there has been an east to west migration of the freshwater fauna in South-eastern Asia. The older genera, such as *Mastacembelus* Cuvier and Valenciennes, *Notopterus* Lacépède, *Labeo* Cuvier, *Barbus* Cuvier and Valenciennes, *Barilius* Hamilton, *Heterobranchus* Geoffery, *Clarias* Gronovius, etc., which are common to Africa and the Oriental region, probably spread from India to Africa at the time of the Cretaceous buckling which, according to Gregory[6] (p. 134), "produced a series of continental valleys trending east and west fragments of which still survive in Africa in the basins of the Zambezi, the middle Congo, and the northern section of the Niger." The physiography of India, however, underwent considerable changes during the Tertiary period.

In elucidating the geographical distribution of animals, great significance is generally attached to the occurrence of the same genus or species on two distinct land masses. According to the more or less accepted views on evolution a species or a genus can exist unchanged through millions of years only if there had been no change in its *milieu* throughout this period. Even gradual changes in the environment of an animal induce fine adjustments on the part of the organism.[8] Any small changes of organisation are utilised by taxonomists in their system of classification. As the science of taxonomy progresses, animal structure is bound to receive closer and closer scrutiny, with the result that a genus occurring over a wide area will be found to consist of several well-defined groups. Isolation and segregation are two very important factors in the production of new forms,[17] and it seems highly desirable, therefore, to pay more attention to the interrelationship of the seemingly divergent genera of different land-masses rather than to look for precisely identical animals in their fauna. The converse is also true. In the case of similar forms occurring in two widely separated places convergent evolution should not be invoked unless no other explanation seems possible. In the two sets of genera mentioned above the truth of these remarks is clearly brought out.

So far I have referred only to the Far Eastern genera that are found in the Indian waters. There is, however, one genus *Etroplus* Cuvier and Valenciennes of Peninsular India and Ceylon which has its close allies only in Madagascar. Günther[7] accounted for its occurrence in India as follows: "*Etroplus* inhabits Southern and Western India and Ceylon, and has its nearest ally in a Madagasse Freshwater fish, *Pareutroplus*. Considering that other African Chromides [Cichlidæ] have acclimatised themselves at the present day in saline water, we think it more probable that *Etroplus* should have found its way to India through the ocean than over the connecting land area; where, besides, it does not occur." I am in agreement with Günther's supposition and believe that *Etroplus* came to India *via* the sea and, after becoming a freshwater form, probably along the Malabar Coast, it remained confined only to the south-western part of the Peninsula, as the rivers of this area probably never became connected with the Indus and the Ganges systems. Further, it seems probable that *Pareutroplus* Bleeker and *Eutroplus* are derived from a common Cichlid ancestoral form that wandered across from the east coast of Africa to Madagascar and South India where they became acclimatised to freshwater conditions independently.

It is generally believed that the land connection between India and Africa disappeared somewhere about the transition period between the Cretaceous and the Tertiary. It is during the obscure interval between the Cretaceous and the Tertiary that nearly all the modern types of bony fishes originated. Regarding the freshwater Catfishes (Siluroidea), to which the Schilbeidæ belong, there is no evidence that they are of any great antiquity; their first known appearance is indicated by some fossils in the Tertiary deposits of the Siwaliks and the highlands of Pedang in Sumatra, where remains of some of the living genera have been found. I have referred above

to the continuity of distribution of the Schilbeidæ from Indo-China to Africa, and the same is true of the Catfishes of the families Clariidæ and Bagridæ. The Clariidæ live in mud in marshy areas of both countries and have thus retained their primitive habits. On account of this we find that *Heterobranchus* and *Clarias*, the two oldest members of the family, are common to the two continents. Tropical Africa with its vast stretches of ancient lakes provided a more suitable *milieu* for these fishes, some of which took to a burrowing mode of life. Consequently they became eel-shaped and their accessory respiratory organs and the associated skeletal elements became degenerate. In India, on the other hand, the conditions were very unstable during the Tertiary period, with the result that the primitive genus *Heterobranchus*, of which fossil remains have been found in the Siwalik formations of the Lower Pliocene, disappeared altogether and only one highly specialised species of *Clarias*,[9] *C. batrachus* Linn., is now found throughout India, while two other less specialised forms, *C. brachysoma* Günther and *C. dayi* Hora, are confined to Ceylon and the Wynaad Hills respectively.

The Bagridæ, like the Schilbeidæ, became established on both the continents at an early date and after the severance of the connection between the two lands evolved independently so that at the present day there is no genus common to the two regions. However, a close parallelism exists between the forms inhabiting similar situations on the two continents. *En passant* it may also be remarked that most of the other Siluroid families of India and Africa are evolved from the Bagridæ.

A remarkable feature of the Schilbeidæ is that no member of the family is found in Ceylon, which may be due to the fact that Ceylon became separated from India at a stage earlier than the disappearance of the land connection between India and Africa. The absence of the Schilbeidæ from Ceylon may also be explained on the assumption that at some period the water courses changed in such a way that in spite of the land connection between India and Ceylon no migration from the north to the south could take place. It is thus seen that unlike the distribution of the land animals, where probably the climatic considerations are of the greatest importance, the aquatic animals are bound within their watersheds and in spite of land connections and favourable climatic conditions between two adjacent lands may not spread from one to the other if their water courses had no chance to become continuous at some period or another. The distribution of fishes, therefore, though extremely important in zoogeographical studies, has thus only a limited value in elucidating the extent of the former land and sea connections.

In this east to west migration of the fauna I have assumed throughout that India was connected with the Far East, at least from the late Cretaceous onwards. This connection was of a very different nature from what it is to-day, for in the early Tertiaries a considerable part of Northern India was under the sea. The Bay of Bengal is considered to be an ancient feature of the physiography of India, so that the old connection between India and the Far East probably stretched over the Peninsula through the coal-field areas of Bengal to the Assam Hills, North Burma and beyond. At certain periods the direct land connection between Assam and Burma was cut off by an arm of the sea, but still Assam remained connected with the Far East through Tibet and Southern China. The distribution of the Indian freshwater fishes affords ample evidence in support of these routes of migration.

I may also refer here to the remarkable similarities between the faunas of the Malay Archipelago, Malabar Zone of South India and Tropical Africa. To account for these anomalies of distribution several workers have been led to establish a southern continent including South America, but of which Madagascar did not form a part. In my opinion when the primitive forms were spreading from Indo-China to Africa they sent branches to the south in all areas over which they passed, and as these southern extremities were away from the main centre of disturbance (the Himalayas) and also somewhat out of the way of the succeeding waves of migration they continued to harbour primitive animals in, what one may say, these corner seats. The islands of the Malay Archipelago, such as Java, Sumatra, Borneo, etc., the Malabar Zone of India and West and South Africa to-day form the limits of the ancient waves of migration and consequently contain many primitive forms, which, owing to the

severance of land connections, could not spread any further. Of the genera I have referred to above, *Heterobranchus* of the Clariidæ shows a discontinuous distribution as it is found in Africa on the one hand and in Banka and Borneo on the other. There is no doubt that even in the Lower Pliocene period its range of distribution must have been more or less continuous, as fossils are known from the Siwalik formations of that period.

It seems highly probable that the southward migration of the Indo-Chinese fauna in the region of the Malay Archipelago must have followed the course of the Indo-Malayan Mountains and of the Malay Arc[5] by a series of river-captures. The strong similarity between the fauna of South India and that of the Malay Archipelago[5] is probably not due to the migrations of the forms *inter se* but to their common origin from an east to west migrating, primitive stock.

In the above discussion I have not taken into consideration the route of migration that now exists between North-western India, through Baluchistan, Persia, Mesopotamia, Palestine, etc., to Africa. This route is known as Jocobi's Arabian region of dispersal and does not seem to have played any important part in the interchange of the freshwater faunas from Africa to India. Some of the Indian forms, however, such as *Glyptothorax* Blyth, *Garra* Hamilton, etc., have undoubtedly spread westwards along this route. *Scaphiodon* Heckel appears to be the only form that may have spread from Persia, Baluchistan and Sind to the Western Ghats.

To sum up it may be stated that the evidence provided by the distribution of the freshwater fishes of India indicates an eastern origin of the fauna and its subsequent dispersal to the west. The close relationship between the Indian and the African freshwater fishes can only be explained on the assumption of a land connection between the two countries. The absence of the Schilbeidæ from Ceylon and their presence in Africa suggests that Ceylon may have become separated from India at a stage earlier than the severance of the land connection between Africa and India. The distribution of freshwater fishes shows that Peninsular India had a land connection with the Far East, at least from late Cretaceous onwards, and probably at no time during this interval it became an island. The similarity in the faunas of South and West Africa, South India and the Malay Archipelago are probably due to the fact that they received branches of the primitive stock when it was migrating from the east to the west along a northern and a considerably more disturbed part of the Oriental region. The above review of the subject clearly shows that there is no African element in the freshwater fish-fauna of India. The existing connection of Africa with North-western India is comparatively of a much more recent date and does not seem to have played any important part in the dispersal of the freshwater faunas.

---

1 Alcock, A., "A Descriptive Catalogue of the Indian Deep-Sea Fishes," 1899, pp. 3, 4 (Calcutta).

2 Annandale, N., "The African Element in the Freshwater Fauna of British India," *Proc. IX^e Intern. Cong. Zool. Monaco*, 1914, pp. 579–588.

3 Day, F., "Geographical Distribution of Indian Freshwater Fishes. Part I. The Acanthopterygii, Spiny-rayed Teleostean Fishes; Part. II. The Siluridæ; Part. III. Conclusion," *Journ. Linn. Soc. London, Zool.*, 1876, **13**, 138–155; 338–353; *ibid.*, 1879, **14**, 534–579.

4 Day, F., "Relationship of the Indian and African Freshwater Fish-Faunas," *Journ. Linn. Soc. London, Zool.*, 1885, **18**, 308–317.

5 Gregory, J. W., and Gregory, C. J., "The Alps of Chinese Tibet and their Geographical Relations," *Geog. Journ.*, 1923, **61**, 153–179.

6 Gregory, J. W., "The Evolation of the River System of South-Eastern Asia," *Scottish Geog. Mag.*, 1925, **41**, 129–141.

7 Günther, A., "The Study of Fishes," 1880, pp. 220-233, Edingurgh.

8 Hora, S. L., "Ecology, Bionomics and Evolution of the Torrential Fauna," *Phil. Trans. Roy. Soc. London*, 1930, **218**, 171–282.

9 Hora, S. L., "Siluroid Fishes of India, Burma and Ceylon. VI. Fishes of the genus *Clarias* Gronovius," *Rec. Ind. Mus.*, 1936, **38**, 347–351.

10 Mori, T., *Studies on the Geographical Distribution of Freshwater Fishes in Eastern Asia.* (Chosen: 1936.)

11 Pascoe, E. H. "Early History of the Indus, Brahmaputra and Ganges," *Quart. Journ. Geol. Soc.*, 1919, **75**, 136.

12 Pelseneer, P., "L' Origine des animaux d' eau douce," *Bull. Acad. Roy. Belgique* (Classe des Sciences), 1905, No. 12, p. 724.

13 Pelseneer, P., "L' Origine des faunes d' eau douce," *Reme de mois, Paris*, 1928, **2**, 413–425.

14 Pilgrim, G. E., "Suggestions Concerning the History of the Drainage of Northern India," *Journ. As. Soc. Bengal* (N. S.), 1919, **15**, 81.

15 Prashad, B., "Recent and Fossil Viviparidæ. A Study in Distribution, Evolution and Paleography," *Mem. Ind. Mus.*, 1928, **8**, 246.

16 Regan, C. T., "The Distribution of the Fishes of the Order Ostariophysi," *Bijdr. Dierkunde Amsterdam* (Max Weber Feest-Nummer), 1922, pp. 203-208.

17 Regan, C. T., "Mendelism and Evolution," *Nature*, 1924, **113**, 569.

18 Wadia, D. N., "The Tertiary Geosyncline of North West Punjab and the History of Quarternary Earthmovements and Drainage of Gangetic Trough," *Quart. Journ. Geol. Mining and Metallurgical Soc. India*, 1932, **4**, 69-9-6.

On the Food Factors of the So-called Mosquito-Destroying Fishes of Bengal.—*Panchax panchax, Barbus stigma, Esomus danricus and Trichogaster fasciatus.*

By P. Sen, M.Sc. (Cal.), Ph.D. (Lond.), D.I.C.
(*Entomologist, Bengal Public Health Department.*)

I. Introduction.

THERE has been much talk in recent times about the importance of fish in the control of Anopheles larvæ and the malariousness of a place. Those who advocate the adoption of biological control measures by the introduction of fish derive their inspiration from the reported achievements of the '*millions*' in the West Indies and *Gambusia* in parts of America in the destruction of Anopheles larvæ. But in the present state of our knowledge it is hardly possible to estimate correctly the importance of fish as destroyers of Anopheles larvæ. Most of the authors based their observations on laboratory experiments. The real test of the effectiveness of fishes in controlling Anopheles larvæ should depend on the determination of what they actually feed in their normal habitat.

In India, different authors have suggested different lists of larvicidal fishes and as time passed more and more new fishes appeared in the lists (Table I). With a

Table I. *List of Larvicidal Fishes.*

Chaudhuri (1911)	Sewell & Chaudhuri (1912)	Fry (1912)	Wilson (1917)	Southwell (1920)	Chatterjee (1934?)
Haplochilus panchax	*H. panchax*	*Haplochilus panchax*	*Haplochilus*	*Haplochilus panchax*	*Panchax panchax*
	H. melastigma	*H. melastigma*		*H. melastigma*	*Haplochilus melastigma*
	H. lineolatus			*H. lineolatus*	
Barbus plutunio	*Barbus phutunio*	?	*Barbus*	*Barbus plutunio*	*Barbus*
	B. stigma			*B. stigma*	
	B. ticto	*Barbus ticto*		*B. ticto*	
	B. terio			*B. terio*	
Ambassis	*Ambassis ranga*	*Ambassis ranga*		*Ambassis ranga*	
	Ambassis nama	*A. nama*		*A. nama*	
Trichogaster	*Trichogaster fasciatus*	*Trichogaster*		*Trichogaster fasciatus*	*Trichogaster fasciatus*
Anabas scandens	*Anabas scandens*	*Anabas scandens*		*Anabas scandens*	*Anabas testudineus*
Badis badis	*Badis badis*			*Badis badis*	*Badis badis*
Clarias magur					*Clarias batrachus*
Saccobranchus fossilis					*Saccobranchus fossilis*
Notopterous kapirat					*Notopterus*
Gobies					*Glossogobius guiris*
Nuria danrica	*Nuria danrica*			*Esomus*	*Esomus danricus*
Carps (*fry*)					*Carps* (*fry*)
	Lebias dispar				
			Chela		*Chela*
			Rasbora	*Rasbora daniconious*	*Rasbora daniconius*
			Barilius	*Barilius* spp.	
			Therapon		
			Polycanthus		
				Wallago attu	*Wallago attu*
				Danio rerio	
					Amblypharyngodon mola
					Ophiocephalus
					Mugil corsula
					Lates calcarifer (*fries*)

view to ascertain how far the indigenous small fishes of Bengal feed on the Anopheles larvæ, a systematic examination of the gut contents of the fish caught in their natural haunts was carried out. The water-collections from which the fishes had been collected were invariably breeding Anophelines. The observations were spread over a period of two years from October 1934 to September 1936.

II. Methods.

The fishes were collected from the various types of water-collections which are usually met with in the neighbourhood of Calcutta and were nearly always brought alive to the laboratory soon after capture. The fishes were dissected as far as possible on the day of catch; in cases where it was not possible to do this, they were preserved in 5 per cent. formaline or in rectified spirit.* The abdomen of the fish was cut open from one side under a dissecting microscope and the mid-gut removed on a slide. The contents of the gut were then squeezed out from one end on to the slide and examined under the microscope.

III. Analysis of Stomach Contents.

Although the food materials in the gut of the fish were often in an advanced state of digestion sufficient clue could still be had in the cuticular or ligneous investment of the ingested organisms to determine approximately their position in the plant or animal kingdom. The contents noted in the dissected gut of the different fishes studied are shown in a tabular form (Table II). No attempt has been made to analyse the food contents quantitatively, only a sorting has been made of the number of fishes showing different organisms.

(1) *Panchax panchax.*—The species is remarkable for its alertness and gregarious habits. They may be found in almost any type of water-collection, be it deep or shallow. They thrive equally well in fresh and brackish water. They are prolific-breeders, the maximum number of ova in a mature ovary varying from 48 to 186. 210 individuals of this species were dissected. These comprised specimens of all ages collected throughout the year, excepting the very dry weather when they were somewhat rare as most of the water-collections were dried up.

The results of analysis of the stomach contents are shown in Table II. This table will give at a glance an idea of the nature of food preferred by the fish. It will be seen that the fish has the greatest liking for Cyclops, Diaptoms and Daphnia and other unidentified Copepods and Cladocera. They feed also on filamentous algæ and other plant life associated with their natural haunts. Evidences of various types of insects, both adults and larvæ, in their guts are not uncommon, and often they take a mixed diet, but I do not see any evidence of special attraction of the fish towards Anopheline larvæ as has been so far supposed. Both larvæ and adults of Anopheline species were equally attacked by the fish; roughly 10 per cent. of the fish examined were found to have devoured the larvæ or the adults of Anopheles. The adult Anophelines were probably caught in the process of emergence when they are generally helpless, or it may be that they were caught at the time of egg-laying on the surface of water.

(2) *Barbus stigma.*—This fish is very common in Lower Bengal and can thrive in any kind of water-collection. It is prevalent in both fresh and brackish water and is essentially a surface-feeder. I have dissected 96 specimens of this species representing all ages during the period November 1934 to January 1935 and again from November 1935 to April 1936. The contents of the stomach are sorted out under different heads in Table II, which shows clearly the nature of the food preferred by the fish. It will be seen that the food consists of almost entirely of the plankton flora and filamentous algæ such as Spirogyra and Oscillatoria. Only a small proportion (less than 10 per cent.) of the fish was found to have traces of animal food which consisted of minute crustaceans of the groups Copepoda and Cladocera. Only one specimen had insect remains in its gut.

(3) *Esomus danricus.*—This is a small very agile fish frequenting fresh-water tanks,

* The act of transference of the fishes from the field to the laboratory usually occupied two to three hours. The time wasted in the transport of the fishes and the consequent delay in fixation might have given a greater chance of digestion of some soft-bodied organisms in the gut of the fishes beyond recognition. But the Anophelines being not soft-bodied forms did not stand that risk, and they could always be recognised in whatever stage of digestion they may be.

TABLE II. *Analysis of the Gut-Contents of Certain Fishes.*

Fish	Paramoecium, Euglena, Eudorina, Heliozoa	Diatoms	Filamentous algæ	Unidentified vegetable remains	Oligochæte worm	Cladocera	Daphnidæ	Copepoda (Diaptomus)	Cyclopoidea	Unidentified Crustacea	Mites	Gastropod shell	Hemiptera adult (Corixidæ)	Hemiptera larvæ	Coleoptera adult (Dytiscidæ, Hydrophilidæ)	Coleoptera larvæ (Dytiscidæ)	Perla	Lepidoptera larva	Chironomid adult	Anopheles adult	Simulid adult	Mycetophilid adult	Ephydridæ (Fly)	Chironomid larvæ	Anopheles larvæ	Anopheles egg	Mosquito pupæ	Dipterous pupæ	Chalcid adult	Ant	Unidentified insect remains	Sand or stones
1. *Panchax panchax.*	10	2	46	34		34	10	28	68	12	4	1	8	2	14	8	1	2	20	20	2	2	20	10	20	2	8	4	8	6	22	1
2. *Barbus stigma.*	7	32	33	31		3	6	3	5	5													1									6
3. *Esomus danricus.*		1		52																1												3
4. *Trichogaster fasciatus.*		20	20	2	2	2		2	10				2																		6	

N.B.—Figures represent number of specimens of fishes showing the different organisms.

ponds, etc. Under natural conditions they do not appear to be actually feeding on the surface of water. Fifty-two specimens of fish of this species dissected showed vegetable contents in the gut, and one of them had a remnant of a mosquito as well (Table II). It is likely that the part of the mosquito was accidentally engulfed in the stomach of the fish. It will also be noticed that the Diatoms and other plankton are strikingly absent in the digestive tract of the fish; this is because of the fish not being a strict surface-feeder.

(4) *Trichogaster fasciatus.*—This is also one of the most frequently met with fish in our Bengal villages. This habitually feeds on the surface of water. I dissected fifty specimens of this kind of which eight showed insect contents in their stomach. Thus nearly 16 per cent. had fed on insects none of which was a mosquito larva (Table II). The Diatoms and the filamentous algæ seem to comprise its chief source of food. Next in order of importance come the Cyclops which constitute nearly 20 per cent. of the diet.

IV. Discussion.

Excepting *Panchax*, the other fishes studied by me did not show any evidence of ingestion of insect larvæ in their guts. Even in *Panchax* which is a carnivorous fish only about 10 per cent. of the fish examined were found to feed on Anopheles larvæ in their habitat. Almost identical results were obtained by Swellengrebel and Swellengrebel (1920). Out of an examination of twenty-six guts they noted remnants of larvæ in two only. The diet of *Panchax* is so varied that it seems to have no selective food-habit, and as such cannot be relied upon as a larvicidal fish. Whatever comes along in their way, whether of vegetable or animal origin, if it is not too big for them, is devoured by *Panchax* as in the case of the types of fish studied by Seal (1910). The field observations seem to show that *Panchax* have greater attraction for small moving objects whatever they may be. The employment of fish which are not known to show a definite preference for Anopheline larvæ cannot therefore prove a success in controlling malaria in Lower Bengal.

Most of the authors seem to agree that the introduction of fish should also be supplemented by clearing the vegetation at the edges of pools and ponds and from the surface of water. In other words without the protection to the Anopheles larvæ which the vegetation is supposed to provide from the attack of fish these larvæ cannot live (Chaudhuri, Nicholls, Fry, Hora). Secondly, it has been suggested by some authors that the tanks, etc., should be kept free of large predaceous fish like murrel in order to give the small larvicidal fish a chance to prove their utility (Southwell, Hora). Thirdly, it is supposed that in the presence of a copious food-supply other than Anopheles larvæ the fish do not act as effective larvæ-destroyers (Molloy). Every practical malariologist knows how difficult it is to fulfil the conditions referred to above. It is therefore not surprising that from time to time various workers have pointed out that the control of Anopheles larvæ by the introduction of fish is not feasible (Lloyd, Seal, Southwell, Swellengrebel and Swellengrebel). In my experience the removal of all aquatic vegetation is in itself an effective anti-larval measure even in places where the supposed larvicidal fish do not occur. As Swellengrebel and Swellengrebel (1920) have put forth, the vegetation acts not so much as protection for the larvæ but as food for the larvæ as well as for the fish. Therefore by removing the vegetation we also take away the normal food factor of the larvæ, naturally the breeding is checked. There is hardly any justification for introducing the so-called larvicidal fish for the purpose of controlling the Anopheline fauna in aquatic areas cleared of vegetation.

V. Summary.

1. The food of the fishes, *Panchax panchax*, *Barbus stigma*, *Esomus danricus* and *Trichogaster fasciatus*, has been investigated by careful analysis of the gut-contents.

2. *Panchax panchax* chiefly depend on the plankton flora and fauna for their food, but have no selective food habit. They live also on a variety of insects in all their stages. Anopheles larvæ were detected in the gut of only about ten per cent. of the total fish examined.

3. *Trichogaster fasciatus* also appear to depend for nourishment on the plankton organisms and the filamentous algæ. Insects form a small part of their diet.

4. *Barbus stigma* and *Esomus danricus* are essentially vegetable-feeders.

References.

Bentley, C. A., *J. Bomb. Nat. His. Soc.*, 1910, **20**, 392-422.

Chatterji, G. C., Central Co-operative Anti-Malaria Society, Limited, Calcutta, **1934**.

Chaudhuri, B. L., *J. & Proc. A.S.B.*, 1909, **5**, xxxvi-vii.

Idem., *Calcutta Med. Journ.*, 1911, **6**, 457-70.

Fry, A. B., *Paludism*, 1912, **5**, 71-74.

Gowdey, C. C., *Bull. Ent. Res.*, 1911, **2**, 182.

Graham, W. M., *Bull. Ent. Res.*, 1911, **2**, 137-39.

Hora, S. L., *Ind. Med. Gaz. Calcutta*, 1927, **62**, 187-88.

Lloyd, R. E., *J. Bomb. Nat. His. Soc.*, 1910, **20**, 1165-66.

Molloy, D. M., *Amer. Jour. Trop. Med.*, 1924, **4**, 175-94.

Nicholls, L., *Bull. Ent. Res.*, 1910, **1**, 213-218.

Osborn, H., *J. Bomb. Nat. His. Soc.*, 1907, **17**, 832-33.

Seal, W. P., *Bull. U.S. Bur. Fish.*, 1910, **28**, 831-38.

Sewell, R. B. S., and Chaudhuri, B. L., Thacker Spink & Co., Calcutta, **1912**.

Southwell, T., *Ann. Trop. Med. & Parasit.*, 1920, **14**, 181-86.

Swellengrebel, N. H., and Swellengrebel, J. M. H., *Jour. Trop. Med. & Hyg.*, 1920, **23**, 3, 77-79.

Wilson, H. C., *Bull. Madras Fish.*, 1917, **11**, 161-72.

Comparative Study of the Determination of Iodine Values.

By N. N. Godbole, V. V. Ketkar, K. V. J. S. Sharma and H. R. Kamath.

(Benares Hindu University.)

I. Introduction.

SEVERAL methods are available to the chemist for the determination of the iodine values of oils and fats. It is undoubtedly of interest to examine these, critically, with a view to determine their adaptability for the investigation of different types of oils and fats under varying conditions.

One of the earliest methods for the determination of iodine values is that due to Hübl.[1] This was followed by the method introduced by Wijs.[2] Later, the methods of Rosenmund[3] and of Margosches[4] came into use but were given up in favour of the other methods. The method due to Hanus[5] has received official recognition in Germany and America for the last many years, and more recently the one proposed by Kaufmann[6] has found favour and is already officially recognised in Germany.

In choosing a method for the determination of the iodine values the following points have to be taken into consideration:—(1) The halogen or the halogen compound used should react with the unsaturated part *only* and form additive compounds; no substitution compounds should be formed in the reaction, even after a prolonged period of contact; (2) The reaction should be rapid, irrespective of the nature (non-drying, semi-drying, or drying) of the oil or fat; (3) The chemicals used should not be very expensive; and (4) The reagents should be capable of being prepared easily and quickly, and should not undergo a change on keeping. The quantity of the substance required has also to be considered in choosing the method and the one which can be adopted for micro-quantities should be preferred.

With a view to compare the accuracy of the four methods, a few typical oils were selected and the iodine values determined for varying periods of reaction. The following oils were used.—(A) *Non-drying*:—Mahua (market sample), Groundnut (cold-pressed in the laboratory); (B) *Semi-drying*:—Sesame (cold-pressed in the laboratory); (C) *Drying*:—Linseed (cold-pressed in the laboratory). The results obtained are tabulated below:—

(A) Non-Drying Oil.

Table I(*a*).

	Hübl	Wijs	Hanus	Kaufmann
Minimum Time Recommended ..	6 to 8 hrs.	30 min.	30 min.	30 min.
Minimum Quantity ,, ..	$\frac{40}{I \cdot V.}$ gm.	0·15 to 1·0 gm.	0·4 to 0·8 gm.	0·5 to 1·[illegible] gm.
Quantity Taken (Godbole) ..	2·0 to 2·5 gm.	0·5 to 0·7 gm.	0·7 to 0·8 gm.	0·5 to 0·7 gm.

Table I(b).
Mahua Oil.[7]
Iodine Value 53–68.

Time	Temp.	Hübl	Wijs	Hanus	Kaufmann
15 min.	33°C.	..	58·57	56·65	57·94
30 min.	,,	..	59·7	57·69	57·87
45 min.	,,	..	59·24	58·35	58·26
1 hr.	,,	..	60·1	57·09	58·30
2 hrs.	,,	..	60·58	58·3	58·09
4 hrs.	,,	53·23	61·38	57·04	58·93
12 hrs.	,,	55·9	..	..	..
24 hrs.	,,	54·1	..	..	..
48 hrs.	,,	50·77	..	..	..

Table I(c).
Groundnut Oil (pressed in the Laboratory).
Iodine Value 86–98.[8]

Oil	Time	Temp.	Hübl	Wijs	Hanus	Kaufmann
Groundnut	15 min.	30°C.	..	89·84	88·14	90·03
	30 ,,	,,	..	91·50	88·04	90·67
	45 ,,	,,	..	92·41	89·18	90·51
	1 hr.	,,	..	92·50	89·03	90·80
	2 hrs.	,,	..	93·77	88·33	91·1
	4 ,,	,,	83·5	95·61	91·68	91·41
	6 ,,	,,	..	..	..	..
	8 ,,	,,	..	..	..	..
	12 ,,	,,	86·25	..	..	..
	24 ,,	,,	83·98	..	..	..
	48 ,,	,,	74·08	..	..	..

Table II.*

Oil	Time	Hübl	Wijs	Hanus	Kaufmann
Groundnut	15 min.	..	..	88·9	..
	30 ,,	..	..	..	89·2
	50 ,,	..	..	88·7	..
	1 hr.	..	89·50	..	..
	2 hrs.	..	89·6	88·6	89·5
	$4\frac{1}{2}$,,	88·5	..	..	..
	6 ,,	..	..	..	88·8
	8 ,,	..	89·2	..	..
	12 ,,	89·4	..	..	..
	24 ,,	88·3	91·8	91·2	88·4
	48 ,,	88·0	..	..	..

* From *Studien auf dem Fettgebiet*, of H. P. Kaufmann 1935, p. 26.

(B) Semi-Drying Oil.

Table III (*a*).

	Hübl	Wijs	Hanus	Kaufmann
Minimum Time Recommended ..	8 to 10 hrs.	1 hr.	30 min.	30 min.
Minimum Quantity ,, ..	$\frac{40}{I \cdot V}$ gm.	0·15 to 1·0 gm.	0·2 to 0·4 gm.	0·2 gm. (approx.)
Quantity Taken (Godbole) ..	0·3 to 0·4 gm.	0·2 to 0·3 gm.	0·3 to 0·4 gm.	0·2 ,,

Table III(*b*).

Iodine Value 103–112.[9]

Oil	Time	Temp.	Hübl	Wijs	Hanus	Kaufmann
Sesame	15 min.	30°C.	..	111·25	103·5	..
	30 ,,	,,	..	111·4	105·0	105·25
	45 ,,	,,	..	111·3	106·15	106·4
	1 hr.	,,	..	112·0	106·5	..
	2 hrs.	,,	..	112·15	105·1	106·0
	4 ,,	,,	100·75	112·2	108·85	106·7
	12 ,,	,,	101·2	..	..	..
	24 ,,	,,	97·8	..	..	..
	48 ,,	,,	94·7	..	..	..

Table IV.†

Oil	Time	Hübl	Wijs	Hanus	Kaufmann
Sesame	20 min.	..	..	109·0	..
	30 ,,	..	112·6	..	110·6
	1 hr.	..	112·9	110·4	..
	2 hrs.	..	112·2	110·9	111·8
	4 ,,	109·4	..	..	..
	6 ,,	..	..	..	112·6
	8 ,,	..	112·4	..	..
	24 ,,	110·0	115·8	113·7	111·2
	48 ,,	109·1	..	..	..

† From *Studien auf dem Fettgebiet*, of H. P. Kaufmann, 1935, p. 25.

(C) Drying Oil.

Table V(*a*).

	Hübl	Wijs	Hanus	Kaufmann
Minimum Time Recommended ..	12 to 18 hrs.	2 to 6 hrs.	1 hr.	45 min.
Minimum Quantity ,, ..	$\frac{40}{I \cdot V}$ gm.	0·15 to 1·0 gm.	0·1 to 0·2 gm.	0·1 to 0·12 gm.
Quantity Taken (Godbole) ..	0·2 to 0·25 gm.	0·1 to 0·17 gm.	0·1 to 0·15 gm.	0·15 gm. (approx.)

TABLE V(*b*).

Linseed Oil—Cold Drawn (pressed in the Laboratory).

Iodine Value 169-192.[10]

Oil	Time	Temp.	Hübl	Wijs	Hanus	Kaufmann
Linseed	15 min.	30°C.	..	173·8	168·1	173·5
	30 ,,	,,	..	176·6	169·85	174·9
	45 ,,	,,	..	177·4	171·4	175·2
	1 hr.	,,	..	177·6	170·6	175·5
	2 hrs.	,,	..	178·7	173·75	175·3
	4 ,,	,,	160·2	179·6	176·9	175·6
	12 ,,	,,	163·4	..	..	..
	24 ,,	,,	159·3	..	..	..
	48 ,,	,,	147·15	..	..	..

TABLE VI.[11]

Oil	Time	Hübl	Wijs	Hanus	Kaufmann
Linseed (Cold Drawn)	15 min.	..	..	171·1	..
	30 ,,	..	175·5	..	..
	45 ,,	..	..	171·1	..
	1 hr.	..	174·5	..	..
	2 hrs.	..	174·6	173·2	171·5
	4 ,,	169·8	..	..	..
	5 ,,	..	..	..	171·6
	8 ,,	..	175·7	..	171·6
	12 ,,	173·6	..	..	..
	24 ,,	172·1	180·7	178·0	172·8
	48 ,,	170·5	..	..	172·4

It will be seen from the experimental data furnished that the results obtained by Hübl's method are not only generally low, but are also varying. The results obtained by the method of Wijs are higher than those obtained by the method of Hanus and of Kaufmann, obviously indicating the formation of substitution compounds, in addition to the normal additive compounds. In the case of the method of Hanus, the results are found to be steady, but after a prolonged action of several hours, slightly higher results in the iodine values (pointing to the formation of substitution compounds) are obtained. The method of Kaufmann gives results which are uniformly steady, and should therefore be the method of choice. The unpublished parallel experiments quoted from the recent book of Kaufmann (*Studien auf dem Fettgebiet*) also point to exactly similar results.

---

[1] *Jour. Soc. Chem. Ind.*, 1884, 641. Dinglers, *Polyt. Jour.*, 1884, **253**, 281.

[2] *Chem. Revue*, 1899, **1**; *Ber.*, 1898, **31**, 750.

[3] Rosemund, K. W., und Kuhnhenn, W., *Ber.*, 1922, **56**, 1262, 2042.

[4] Margosches, u, Mitarb, *Ztschr. angew. Chemi*, 1924, **37**, 334, 982.

[5] Hanus, *Ztschr. Unters. Nahr.-u Genussmittel*, 1901, **4**, 913.

[6] Kaufmann, H. P., *Ztschr. Unters. Lebensmittel*, 1926, **51**, 5.

[7] Holde Bleyberg. *Kohlenwasserstofföle und Fette*, Julius Springer, Berlin, 1933, 7th Edition, p. 788.

[8] *Ibid.*, p. 792.

[9] *Ibid.*, p. 794.

[10] *Ibid.*, p. 800.

[11] Kaufmann, H. P., *Studien auf dem Fettgebiet*, 1935, **25**; *Verlag Chemie, G.M.B.H., Berlin.*

OBITUARY.

Prof. K. K. Mathur.

PROFESSOR KRISHNA KUMAR MATHUR's premature death on July 18, 1936, deprived India of an eminent geologist and an educationist. Though of late he had been suffering from a prolonged illness from myloid leukæmia, an incurable disease, the news of his death has come as a sudden shock to every one who knew him. Educational career of Professor Mathur has been all through very brilliant. In all examinations he stood first and secured merit scholarships. After finishing the secondary education he joined the Agra College. It was here that he came in close contact with the inspiring personality of Prof. N. C. Nag. He graduated in the year 1915 and topped the list of the successful candidates of the Allahabad University. The Government awarded him a scholarship for studies abroad in the year 1916. This he availed in spite of the troubled atmosphere of the last Great War in Europe. In England he prosecuted his studies at the Imperial College of Science and Technology, where he took the Associateship of the Royal School of Mines in Mining and Mining Geology, and the B.Sc. degree in Mining, with First Class Honours, of the University of London. There too he stood first amongst the successful candidates of his batch and was awarded the De La Beche Medal.

Late Prof. K. K. Mathur.

Soon after his return to India Prof. Mathur's services were secured by the Benares Hindu University as the University Professor of Geology in the year 1921. There he soon established himself as a great teacher and administrator. The Department of Geology owes its growth and development to Prof. Mathur who was its Head from the very beginning. His love for the science of geology was great and he was keenly devoted to it. His personality attracted students from all parts of India. At Benares he built up a school of geology, which is all India in its character. His indomitable spirit in the face of hardship and his great love for the science of geology, were a source of great inspiration to his students, who are spread far and wide in India and some of them hold important offices. His colleagues in the University held him in the highest esteem, and when he was appointed Principal of the College of Science constituted in 1935 every one was indeed very happy at the selection.

In the field of research his principal contributions comprise the Petrology of the Deccan Trap Igneous Activity. He carried on investigations of the study of the various differentiates and threw much light on the genetic processes leading to the formation of the different types. His Presidential Address to the Geology Section of the Bombay Session of the Indian Science Congress, 1934, on this subject will continue to be a valuable work of reference for a long time to come. His research activities also extended to stratigraphy, mineralogy and colloidal chemistry.

Amongst the scientists in India he held a prominent position. He was Vice-President of the Geological, Mining and Metallurgical

Society of India for two sessions. He was a foundation Fellow of the Academy of Sciences, U.P., now the National Academy of Sciences, India, the Indian Academy of Sciences, and of the National Institute of Sciences of India. He presided over the Geology Section of the Indian Science Congress, held in Bombay in the year 1934.

In the Benares Hindu University he was a prominent figure in all the administrative and academic bodies. He was a member of the Court, the Council, the Senate and the Syndicate, and had been the Dean of the Faculty of Science for two consecutive terms. He also served on the Faculties of Arts and Ayurved and numerous other boards of studies. He acted as the Honorary Secretary to the Hindi Publication Board, and it was due to his enthusiasm that a splendid set of scientific books in Hindi, the principal Indian language, was published. He was President of a number of local social bodies and took an active interest in all of them.

On the personal side, Prof. Mathur was a man of strong principles and high ideals. As an administrator his sense of justice was great, which won for him love from all quarters. He was strict in imposing rules but very liberal in judging faults. He was simple, sincere and a great philanthropist. His purse was always open for the poor students and for the cause of science. He carried his greatness with charming modesty, and was a paragon of politeness and gentlemanliness. He was a selfless and conscientious worker. Whatever work, whether great or small, of scientific or of social nature, he took up he used to put his heart and soul into it with the result that he used to overwork himself, a practice which he continued even during his illness. His friends and doctors constantly advised him not to work so hard. But all such advice was vehemently opposed as life to him without work had no meaning. He hardly enjoyed a vacation. As the nature of his duties demanded his presence at the University all through the working session, he had to lead geological excursions during the hot months of May and June and that too sometimes to places like Rajputana, Cutch and Kathiawar. This prolonged strain of work with little rest was perhaps responsible for bringing such a brilliant career to a close at the early age of forty-three. May his soul rest in peace!

B. Jayaram (1872-1936).

THE death of Mr. B. Jayaram, F.G.S., retired Director of the Mysore Geological Department, on the 4th December 1936, deprives the State of one of its pioneer geologists who were mainly responsible for its preliminary Geological Survey.

Bangalore Jayaram was born in March 1872 and after undergoing a course of study in physical science at the Central College, Bangalore, he joined in 1895 the Mysore Geological Department as one of the batch of apprentices who were selected when that department was organised. During the period of his apprenticeship, the first two years of his official career, he was under practical training along with the rest of the apprentices, in Geological Survey and mapping under the guidance of the distinguished geologists Bruce Foote and Dr. Evans. In 1901 he was sent on deputation to England for a course of further study in Petrology under the late Prof. Judd, at the Royal College of Science, London.

Passing through the several grades of Assistant Geologist, Senior Geologist, and Deputy Director, Mr. Jayaram rose, in 1919 to the position of the head of the department as its Director and continued to hold this post till his retirement from service in February 1927. Initiated by Dr. W. F. Smeeth into the study of complex crystalline schists, Mr. Jayaram spent the early years of his service in a detailed investigation of the structure and character of the rocks of the Kolar Gold Field, as a result of which he prepared an elaborate geological map of the area and contributed several short notes on the nature of the rock types exposed in the region. From 1908–13 he was engaged in surveying the southern portions of the Mysore district and the hilly tracts of Closepet. Subsequent to 1914 and till the period of his retirement, he examined many portions of the central and northern parts of the State to effect the needed revisions in the preliminary mapping. His work during these later stages has raised many doubts and controversial questions which unfortunately he could not completely investigate, and as such he has contributed only

short descriptive notes of the several areas he examined, drawing attention to any specific points which in the light of his views needed further investigation. Though an indefatigable field geologist and a very keen observer, Mr. Jayaram was not a prolific writer and consequently left unsaid many of his views which might have been of good service to others. He believed in silence and preached silence and seldom encouraged free discussion of views.

Mr. Jayaram was an all-round sportsman and an able cricketeer. He was selected to play for India as one of the teams which toured England in 1911 and after his return from this tour owing to the increasing responsibilities in his official life, he discontinued taking active interest in cricket. His recent article "On Reminiscences of our Cricket days" contributed to the "Hindu", only a couple of months prior to his death, giving a vivid account of his sporting days, should still be green in the minds of the cricket enthusiasts in India.

As a man Mr. Jayaram was somewhat impetuous and occasionally short tempered which often led him to estrangement with some of his associates. But still, he was large hearted and was generous sometimes, even to a fault. He liked the unostentatious native wit of the uneducated villager much better than the book learning of the modern college trained graduate.

After his retirement from service Mr. Jayaram took to fruit culture as a hobby and practically withdrew from the bustle and scene of the City life to seclude himself in his garden villa some distance from the City, where he spent the rest of his days amidst peaceful surroundings and rural scenes till within a few days of his death.

B. R. Rao.

Vitali's Test for Mydriatic Vegetable Alkaloids.

By K. R. Ganguly, M.Sc.
(*Government Laboratory, Agra.*)

In India Dhatura poisoning cases are of frequent occurrence. In fatal cases, due to climatic conditions of the country, sometimes decomposition sets in before the autopsy can be held. Under such circumstances when a mydriatic alkaloid is detected in the viscera, it is desirable to supplement the mydriatic test by Vitali's test if fragments of Dhatura seeds are not found in the contents of the stomach or intestine.

In connection with the application of Vitali's test, it is found from the literature on the subject that some use ordinary nitric acid for the oxidation, others, fuming nitric acid. Some prefer heating the basin for a short time over a flame before evaporating the excess of nitric acid on water-bath, while others omit this preliminary heating. Regarding alcoholic potash some advocate the use of 4 per cent. solution, while others use a 10 per cent. solution.

Experiments performed by me showed that it makes no difference in the reaction, whether ordinary or fuming nitric acid be used, but heating the basin over a flame for a short time prior to complete evaporation on the water-bath gives better reaction.

As for the reagent alcoholic potash, it was found that the higher the strength of the alcohol, the better was the result. A series of solutions of KOH in absolute alcohol ranging from 2 per cent. to 20 per cent. KOH was prepared and the tests carried out. The 2 per cent. solution yielded no colour, the 3 per cent. solution gave a faint positive reaction, whereas definite positive reactions were obtained with solutions of 4, 5, 10, 15 and 20 per cent. strength.

The Vitali's test carried out as mentioned above was noticed to be less sensitive in summer than in winter. But there was marked improvement in the reaction, when the basin containing the residue under test was cooled by placing it on ice for a few seconds avoiding the formation of dew drops inside it.

As for the colour developed by Vitali's reaction, in my experience, atropine, hyoscyamine or hyoscine all give a purple or a purplish violet, gradually or rapidly fading away, without giving a definite red shade as has been noted by others. The time factor for the fading of the colour is dependent on the amount of alkaloid present.

The test when carried out in the following way gave excellent results.

The alkaloidal residue extracted by the Stas-Otto process from the viscera is obtained in a dried condition in a porcelain basin. It is then treated with a few drops of nitric acid, the basin is passed over a bare flame till acid fumes are given off and then the liquid is completely evaporated on water-bath avoiding dust to fall in the basin. After cooling the basin,—if necessary by placing on ice for a few seconds avoiding the formation of dew drops in it, the oxidised alkaloid is touched with a glass rod moistened with cooled freshly prepared saturated solution of KOH in absolute alcohol.

By this process 0.0004 mg. of atropine could be detected by the Vitali's test in place of 0.001 mgm. of the alkaloid as was claimed by the author of the test.

If the Stas-Otto extract contains excessive impurity as happens when putrefaction of the cadaver has set in, it interferes with the test. In such cases the residue obtained, after evaporating the excess of nitric acid, is often distinctly brown and the characteristic colour of the atropine group of alkaloids developed on the addition of alcoholic potash is either completely masked or is faint. The presence of other alkaloids also, particularly strychnine, interferes with the test. Strychnine after treatment with nitric acid leaves a yellow residue which, with alcoholic potash, gives a faint transient purple immediately changing to reddish brown. In such cases the interfering substance may be completely got rid of by the following process, and then the Vitali's test may be applied with success.

If on the addition of alcoholic potash to the residue oxidised with nitric acid, the colour reaction of the atropine group of alkaloids is not definite, the residue treated with alcoholic potash is transferred by means of distilled water into a separating funnel. The alkaline liquid is then shaken up twice or thrice with petroleum ether. The combined petroleum ether extract after separation is shaken up several times with faintly alkaline water, until the watery layer shows no more colour. The petroleum ether extract is then transferred into a round-bottomed porcelain basin and evaporated off. It is of advantage to concentrate the residue at the bottom of the basin by washing down the side with a few drops of chloroform and then removing the chloroform, first by spontaneous evaporation and finally on a water-bath. If now the alcoholic potash be added to the cooled residue, the characteristic colour of the atropine group of alkaloids is distinctly developed. In case traces of the interfering substance be still present, a second extraction with petroleum ether may be done.

Vitali's test needs only to be applied when a mydriatic alkaloid is found to be present.

This investigation was carried out under the facilities kindly afforded to me by Mr. D. N. Chatterji, B.A., B.Sc., F.I.C., the Chemical Examiner to Governments, United Provinces and C. P., in his laboratory. I am indebted to him for his kind permission to send this paper for publication.

Peking Man.

THE interest attached to the recent discovery of additional material in the form of five new skulls of *Sinanthropus pekinensis* in a more or less perfect state of preservation has proved to be considerable. The new skulls are even better than the older finds and what is more important, they are adult skulls, while hitherto, the skulls of only adolescents were known. These five skulls along with a sixth which Prof. F. Weidenreich (Director of the Caenozoic Research Laboratory of theGeological Survey) is reconstructing from fragmentary material will form the "richest and most complete collection of human fossils ever recorded, unique in every respect".

While it is still too early to forecast the trend of the conclusions which these discoveries may lead to about the ancestry of Man, it is probable that Prof. Weidenreich's earlier observations that the Peking skull stands intermediate between those of *Pithecanthropus* and Neanderthal man, may be substantiated. It is to be hoped that every assistance and co-operation will be afforded to Prof. Weidenreich in the important task he has undertaken.

SUPPLEMENT TO "CURRENT SCIENCE".

Vol. V] INDIAN SCIENCE CONGRESS, HYDERABAD, 1937. [No. 7

Presidential Address.

The Indian Village—Its Past, Present and Future.

By Rao Bahadur T. S. Venkatraman, B.A., I.A.S., F.N.I.

Introduction.

I TAKE it no apology is needed in these days for talking about any aspect of 'village and village life'. The city and the town which were holding a complete thraldom over the public mind all these years are losing their glamour somewhat in spite of their admittedly alluring attractions; and the 'village' would appear to be getting increasing recognition, particularly in our country and in recent times.

I propose to speak to you to-night under the caption 'The Indian Village—Its past, present and future'. You might perhaps question my claim to speak on this subject as all my official life and thought for the last quarter of a century has been linked up almost entirely with sugarcane. But this very work has often taken me to the countryside in various parts of India and my contact with the Indian village has been fairly intimate. While at my special work I had perforce to witness the pleasures and tragedies of the villager and watch the changes that are steadily coming over the village. Secondly, most of us—in this agricultural land of ours—have come from villages and are in fair contact with village life either directly or through our kith and kin.

One easily noticed change, in the village, is the migration of the villagers to the town. The richer of the villagers show a tendency to shift themselves to the nearest town or city for the education of their children, for better medical help or for the characteristic amenities associated with urban life. Secondly, the more intellectual of the younger generation, who first migrate to the towns for their studies or to seek employment, do not generally return to the village, but settle in some town which they find more congenial for the full scope of their talents. If they do pay a visit to the village it is either to see an old relative who is too conservative to move to the town or in connection with some matter which renders their presence in the village unavoidable. Such visits are made of as short duration as possible and they get back to the town with almost a sense of relief.

Position of India with Reference to Space and Time.

But before getting into the subject proper it is necessary to record here a few general observations on the position of our country with regard to both space and time viewpoints. With China, Japan and the South-Eastern islands, India is situated in a comparatively densely populated area of the globe—about half the population of the world being crowded into a tenth of the Earth's land region. This has had its effects on the type of agriculture practised in the country, the selection of crop for cultivation and the life of the people as a whole.

Secondly, along again with China, India possesses a civilization and culture which was at least contemporaneous with, if not antecedent to, the civilizations of Egypt, Mesopotamia, Greece and Rome. After making considerable progress this civilization has, however, remained in a more or less quiescent and petrified state in our villages for well nigh two to three thousand years, little influenced by the great progress made by the West during the latter part of the same period. It is only within comparatively recent times that the Western civilization has come to spread into and influence the countryside. In more senses than one the Indian town represents the dynamic West with all the vigour of youth and the village the comparatively quiescent East. Certain of the problems of the village to be discussed hereafter will be found traceable to the inevitable contact between the two.

Aryan Colonization of India and Types of Villages.

The Aryans, who entered the country through the North-West route, first occupied the Indus valley and the Punjab plains and later spread to the east of the Jumna as far as the Saraswathi. Subsequently they spread into Bengal and from there would appear to have sent out expeditions

by sea to Burma, Ceylon and Java. The Vindhya ranges and the Aravalli hills long acted as an effective barrier against large movements southwards into the Deccan and South India. The country to the south of these ranges remained for long Dravidian, though increasingly influenced by Aryan culture from the North.

The Ryotwari village.—The new Aryan colonists naturally found plenty of land to settle in and the obvious advantages of group formation brought into being two main types of villages. One was the type similar to what is now termed 'ryotwari' where each family or group of persons took up as much land as they could cultivate depending on the number of cattle and able-bodied men in the unit. Site for the village was chosen at some convenient spot such as the banks of a river or canal or proximity to other sources of water-supply. The persons constituting the village chose a headman who exercised all powers on behalf of the whole community. This type of village was generally associated with peaceful conditions.

Joint village.—The other type called 'Joint Village' by Baden Powell was founded by powerful families or clans not necessarily agriculturists. The government of such villages was by the well-known Panchayat system and occasionally a group of such villages belonged to the same clan or owed some kind of allegiance to the same warrior chieftain in return for the protection they enjoyed at his hands. In these villages the cultivating classes were sometimes in the position of tenants. 'Ryotwari' villages sometimes got converted into 'Joint Villages' through conquest by some warrior chieftain.

The Great Change in the Village.

To realize fully the present conditions of the Indian village and understand its problems it is necessary to briefly notice here the changes that are coming over it and the reasons for that change. The Indian village of ancient times was practically a self-contained, self-governing unit, having but little contact with the outside world. It grew all the crops required to meet all its simple needs and the surplus of good years was stored in the village granaries as a provision against future unfavourable seasons. The people of the village lived like the members of a big family under the accepted leadership of the village elders—the Panchayatdars. Land was plenty, needs few and there was a great deal of contentment. The villager's outlook and knowledge were limited rarely extending beyond the confines of his own village and the villager's life ran an even course from day to day. This had been the condition for well nigh two to three thousand years.

One very important result of the contact with the West has been the development of the export and import trades which have affected profoundly the kind of crops grown and both the occupation and mode of life of the villager. It is steadily dragging him out of his isolation and throwing him into the world currents of commerce and industry. He is not content to grow crops to meet the needs of his own village but finds it more 'profitable' to grow what are termed 'commercial' crops for outside markets as distant as New York or London. This has upset the old time food centred economics of the village and rendering them increasingly money centred. The more enterprising and intelligent of the villagers are attracted by the commercial life and tend to shift themselves to the nearest town or city temporarily in the beginning but often permanently in the end. It is no wonder that such great changes have brought in their train a variety of problems connected with our villages.

The Present-day Village.

Village Agriculture.

As agriculture is the sole occupation of the villager its present condition and its effect on the economics and life of the villager are well worth consideration. One outstanding feature connected with Indian agriculture is its great dependence on the monsoons. In spite of the great irrigation works—some of them the largest in the world—and the steady advance in the matter of tapping underground water, it has been estimated that seven-eighths of our agriculture is yet dependent on the monsoons.

Secondly, the villager is so little in touch with world markets wherein the results of his labours are evaluated and sold, that a large portion of his profits is intercepted by the intermediate agencies that market his produce.

Thirdly, land available for crop growing has not increased to the same extent as increase in population. True some new lands have been brought under the plough and yields from existing lands have increased somewhat, but such increase is much less than the increase in population.

Fourthly, possibility of large augmentation in acre production is severely handicapped by a variety of causes such as Subdivision and Fragmentation of holdings and the prevalence of rigid social customs and religious sentiments which cause the waste of such valuable manures as night soil and cattle dung and adversely affect the business aspect of agricultural production. Both Sub-division and Fragmentation are interrelated to each other and result from the same cause, *viz.*, the mode of inheritance of landed properties as obtaining in both the Islamic and Hindu laws.

Village Cattle.

The Aryan settlers loved their cattle and valued them highly. A grazing waste round each has been the standard feature of the Indian village. Unlike China and Japan where the consumption of milk as food is considered a disgusting habit, this article has been highly valued in our land and extensively used as food from ancient days. This is fortunate for a country like ours which otherwise is largely vegetarian. Milk was not banned even in the case of the semi-recluse who was denied most other articles of diet. In the Brahmanical period the daily prayer included an invocation for the health and prosperity of the cow.

The cattle represents sometimes the heaviest capital outlay of the cultivator next only to land and he loves them almost to a fault.

But this very attachment and religious regard to the cattle—particularly the cow—is now working to their disadvantage. India is unique in possessing an enormous amount of cattle without making profit from its slaughter. The old and the weak are allowed to deplete the fodder stock of the village with the result that the fitter and hence the more useful ones do not get their due share. Cattle maintenance is not looked upon as a business proposition and the sentiment towards them is similar to that of a rider to the old horse which had served him well when he was fit and strong, or of the lady aristocrat to her pet dog or cat in the West. The sentiment is too deep-seated for a rapid change.

The Motor, the Oil-Engine and Electricity are steadily replacing cattle power (largely of the male sex) for transport and water lifting. On the other hand, the demand for milk and milk products is likely to increase in the future and it is desirable it should be so. Fewer but better type of cattle and tended with greater knowledge of their needs, are indicated in the future. Castration in as painless a manner as possible to work out the uneconomic types from the village stock is the crying need of the countryside. The world is getting accustomed to such ideas even in the human species. With increasing knowledge of factors determining the sex of the fertilized egg will science be able to increase the number of heifers as perhaps in the future we might need more cows and less bullocks ?

Village Labour.

For agricultural labour the Aryan colonists would appear to have employed largely the local people—the Dravidians and aborigines. The Indian labour is low both in wages and efficiency, certain extremist opinion equating a week's labour of the Indian to a day's of the Westerner.

But the demands of agriculture are such that, whereas at certain periods a large force of labour is needed, there is no demand during other parts of the year. This is particularly the case where the bulk of the area in the village is under the same crop. In the absence of work and hence wages all the year round, the labour migrates to other places with the result that, at the time of peak demand (as during paddy transplantation) there is labour scarcity. Crops like the sugarcane which need labour all the year round, greater diversity of crops or subsidiary occupations are needed for stabilizing the labour demand.

The Villager (and His Indebtedness).

Having briefly considered certain important aspects of village life, we are now in a position to consider the present condition of the villager himself. Though till recently but little affected by the changes around him, on account of his isolation, both mental and physical, he is being made increasingly aware of the changes around by the extension into the village of such symbols of modern life as the Post and Telegraph, the bicycle and the motor bus. Frequently also the village is visited by the townsman who is only too eager to demonstrate before the awe-struck villager the elegances and conveniences of urban life.

Economically he finds himself in a very disadvantageous position owing to his steadily diminishing agricultural income in contrast with increasing expenditure due to changes in living even in his own household. Innovations in dress and habits and new wants like tea and coffee are steadily forcing up family

expenses. While the community life of interdependence has ceased to exist, the medieval social structure like the joint family system still persists rendering the villager's life unbalanced.

Dependant as he is solely on agriculture, the need for money always exists. This is true of the agriculturist all the world over and results from the fact that, whereas agricultural income comes in only at particular times like harvest, his expenditure is of a monthly if not of a daily nature. Extra profits from an exceptionally good year are more often wasted in urbanizing his surroundings than being put by as reserve against lean years. The heavy indebtedness of the Indian villager is well known and has attracted the attention of all that have cared to study the village.

The villagers' debts are also often unavoidable. It has been calculated that nearly 90 per cent. of a villager's expenditure is on such essentials as food, clothing, rent and taxes, thus leaving but little margin for unexpected reverses such as crop failures or floods or sudden cattle mortality. Expenses on marriages and funerals, which to the villager are equally unavoidable because of his traditional ideas, are other sudden items of expenditure. The margin of extra income is so narrow that the loss of a buffalo or the long illness of the working member in the family is known to drop the villager down in the social scale sometimes never to recover to his original position. The only security he can offer against such debts is the land, his only possession in this world, and once pledged he finds it difficult to redeem it.

While on the subject of the economics of the villager it will be appropriate to consider here the various types of waste that are taking place in the village. Foremost, perhaps, is the agricultural waste resulting from the uneconomic sub-division and fragmentation of land which precludes its cultivation to maximum benefit. Then come the waste of cattle and human labour due to fragmentation, the drain of village money by way of interest on loans raised by the villagers and loss of valuable manures like human and cattle voids. Cattle manure is wasted as it is needed for fuel. It is such a suitable fuel in the Indian household that a substitute alone will be operative in bringing about its rapid discontinuance as fuel. Human voids instead of being utilized as in China and Japan, are allowed to render the streets and surroundings unsanitary and poison the clean country air. There is considerable waste of both energy and material resources through adherence to sentiments and habits which, perhaps useful in olden times, are useless and wasteful under the changed conditions of to-day.

One important waste which has to my mind far-reaching results is that caused through forced idleness. This is because agriculture, which is often the sole occupation, is not able to keep the villager busy all the year round. This forced idlenesss is very harmful, changes his whole outlook on life and lowers his character in many ways. No tonic is so good as healthy and steady work all through the year and this is denied to the average villager. The comparative prosperity of villages located near towns or industrial centres proves the advantages of employment all through the year.

The Exodus from the Village.

The most serious of the unfavourable changes coming over our villages is the steadily increasing exodus of people from the village to the town. There is little doubt that the villages were comparatively more populous in the olden days. One main reason for this exodus is the growing inadequacy of agricultural income not supplemented by income from other sources. A second reason is the shifting of the main activities of life to the town. Educational facilities and other urban conveniences are increasingly attracting the villagers to the town. Dr. Mann was struck by the significant absence from a Bombay village of youths between the ages of 14 and 20; and this is largely true of other provinces as well. They had gone out for education or to seek employment.

Apart from the number, the quality of human material contained in the exodus constitutes a serious drain. Take, for instance, a family of four sons all of whom had gone to the nearest town for education. The successful ones get employed away from their villages in due course and rarely return to it except if at all in old age. The unsuccessful ones, on the other hand, with nothing else to do perforce return to the village and settle there, thus increasing the pressure on the land often disproportionately to their contribution to the village assets. Secondly, the richer landlords who, by their superior resources, could, if they cared, undertake experiments or launch fresh agricultural ventures, are attracted to the town and leave behind in the village their less resourceful

brethren. Similarly, the capable artisan leaves for the town to make the most of his talents. Culture is now town-centred and there is little scope in the village for the full development or unfolding of one's talents. In the olden days when the village was practically autonomous and had its own funds to cater to the needs and amenities of the village the opportunities in the village were greater ; and it was possible to retain in the village at least a portion of the intelligentsia, though even then the best of talents resorted to the capitals or courts of Kings for patronage.

THE FUTURE OF THE INDIAN VILLAGE.

After this rapid review of the Indian village in the past and the changes that have been coming over it up to the present time we are now in a position to consider its future. There is little doubt that the general tendency so far has been for the village to steadily go down in prosperity and importance in contrast to the town which has increasingly drawn the best from the village. The question to consider is, if this is in the best interests of our country and, if not, are any steps needed to place the village in a better position than now. Does the future lie in a greater and further development of urban life, evolving measures that would somewhat mitigate the inevitable disadvantages associated with it or does the situation need radical changes in the village and village life, importing into it certain characteristics of the town ?

In spite of its having become trite, the statement that ours is an agricultural country warrants repetition on account of its far-reaching effects on all our activities. The plough with a pair of oxen is perhaps the one symbol that would properly represent India as a whole with its different classes and communities. Secondly, the rapid increase of population in our country and China has become a byword and this renders incumbent a further increase of agricultural production. Science has so far not succeeded in growing crops on the roofs of houses or on road-sides in towns and the best achievements of agriculture have been in the countryside. The clearly indicated line of advance for the future, therefore, lies in improving rural conditions and rendering our villages better and more efficient in the discharge of duties set to them by the country as a whole, *viz.*, (1) the proper and adequate feeding of the steadily increasing population, and (2) rearing a healthy stock of men and cattle and maintaining them in a fit condition.

Both town and village are needed for the full and complete development of our country as a whole. The town is a natural and inevitable product in this development. 'If God made the country' the town was and is being made by man, His agent, and in response to forces no less natural in the broad sense of the term. Ours has been and still largely is a land of villages but the towns have risen up and are bound to multiply and expand in the future. In recent times there has been a growing tendency to centralize culture and activities in the town to the disadvantage of the village ; and the towns and cities have in a sense grown at the expense of the village.

But each has certain specific advantages and inevitable defects. In crop growing, when one comes across two types both of which possess desirable characters, the crop servant—called the Breeder—tries to raise hybrids between them for producing kinds which might combine in themselves the good points of both and eliminating as far as possible the defects of either. This process of hybridization is neither new nor recent. Nature has been doing this since the beginning of life and the existing crop types are the result of such so-called 'natural' hybridization and selection. A similar procedure is indicated between the town and the village and such a process is already in progress. The open air extensions that have grown round towns in recent years—with compound houses and gardens—indicate the attempt to ruralize the town in the matter of health and surroundings, while the Post Office, the rural dispensary, the school, and even the bus horning its way through the village are in the nature of urbanizing the countryside. Suburban colonies also represent such an endeavour to combine the advantages of both country and town life. While the process is already in action it is desirable to speed it up by conscious endeavour.

Improving Agricultural Efficiency.

Elsewhere we have considered certain serious handicaps the present-day village agriculture is labouring under. Thanks to the good work inaugurated by Lord Curzon's Government about thirty years ago reinforced and supplemented by the elaborate and far-reaching recommendations of the ROYAL COMMISSION ON AGRICULTURE of 1930, we are now in a position to feel that technical advances in agriculture and allied sciences can be taken to have been provided for. The Imperial Council of Agricultural

Research, a lusty child of the Royal Commission, has already won back to us a major industry and is engaged in grappling with problems of fundamental importance like marketing.

While on this point I cannot resist the temptation to refer to the outstanding achievements in the breeding of valuable crop types. Our most rapid and effective advance in agriculture has been along this line and to-day almost every crop is being systematically bred all over the country. Advance in this direction—*viz.*, the improvement of crop type and distribution of its seed—has been the most suitable to our present conditions of comparative poverty of resources in other directions. For the production of these types the resources in the way of plant material of more than one country has been and is being systematically employed. Combined with substantial Tariff protection afforded by a kind Government, it has resuscitated our sugar industry and thus saved a drain to the country of 15 crores of rupees per annum on the average. It is employing a hundred thousand additional labourers in the factories and about 1,500 graduates in these days of unemployment besides the five million extra agriculturists directly benefiting from it. This demonstrates the great value to the country as a whole of industries founded upon our own agricultural products.

That it is possible to augment the agricultural income of the villages to a considerable extent is evident from the fact that even in the West, which is much more advanced in this matter, the opinion is held that further marked advances are possible. A recent theoretical calculation has shown that, under the best of conditions and with the needed machinery and organization, twelve able-bodied men are sufficient to cultivate 365 acres of sugarcane and from it supply the carbohydrate needs of as many as 14,500 men and that thirty-five individuals could be fed from the produce of one acre, if properly handled. It is true that these calculations are somewhat theoretical as they assume conditions which do not exist and which it may be difficult to fully materialize, yet they are useful indicators of possibilities in the direction.

The evils resulting from sub-division and fragmentation of holdings have already been noticed. These are beyond the capacities of technical departments to remedy, however earnest or well organized they may be. They are caused by ideas and sentiments deep-seated in peoples' minds and legislation is the only remedy. It is a matter where we have to help ourselves and submit to certain hardships in the interests of the country as a whole. Other countries have shown the way. In Austria the economic holding is recognized by the law of the country and is both indivisible and unmortgageable (except for short periods). In Italy such holdings are said to be inalienable, indivisible and unseizable. In Denmark a law passed in 1837 provides for the proprietor leaving his farm intact to any one of his children and providing moderate consideration for his other heirs. It is gratifying that certain provinces have initiated action in this direction.

The Human Element.

Literacy and education.—As the efficiency of any programme of rural improvement depends primarily on the Chief Agent in it, the Villager, it is important to consider means for increasing his efficiency. If we compare the Villager with the Townsman one point in which the latter often scores over the villager is his literacy if not always his education. This is not the place nor is it necessary to detail the various advantages of education or even literacy. Suffice it to say that even in elementary education we have a very effective weapon for bringing the villager out of his narrow horizon, breaking down his superstitions, placing him in touch with the rest of the world through the printed word and for facilitating the introduction of various reforms for his betterment. In the progressive evolution of the human species acquisition of certain characters such as the 'erect habit' are credited with having introduced far-reaching effects. Education belongs to this category.

Though it is true that the village teacher did exist in the olden days and at least certain classes of the population received some kind of school and even higher education and though there is evidence that reputed universities did occasionally flourish in certain rural parts, regular schooling and education were not considered essential.

Education given in the village school should obviously possess the rural and agricultural outlook and be vitally linked with the every-day life of the village. In our boyhood days we learnt more about the geography and history of places we could never hope to see while being comparatively

ignorant of our own district and its environment. Such an important subject as the anatomy and physiology of the human body was reserved till the student had mastered the various distinguishing characteristics of the metals and the non-metals or the names of the then two important towns in the Sahara region. There is now a steady and welcome change in this matter. Nature study lessons fit in well the agricultural life of the villager and I have often wondered why the village vacations should be timed to the conveniences of metropolitan examinations rather than to the busiest agricultural seasons in the village when the boys could perhaps help their parents in the field and gain first-hand knowledge of subjects taught in the school-room.

Intellectual alertness.—A second characteristic of the Villager as contrasted with the Townsman is often the slower moving intellect of the former. This is not mentioned here in a derogatory spirit; the difference is due to difference in the environment. The every-day struggle with the great forces of nature develops a deeper character in the villager, but in intellectual alertness he is often inferior to the townsman. Agricultural operations are generally spread on the broad land and hence the workers are in comparative isolation, whereas intellectual alertness is greatly accelerated through contact and clash with other minds, a feature of industrial life. The rather extreme opinion has been held that most agricultural improvements themselves have been from men whose intellects have been sharpened by industries and commerce. The linking up of villages with towns and other villages, through better communication facilities, for instance, will remedy the situation.

Business habits.—Yet another common defect of the villager is the lack of so-called 'business' habits and 'business' mentality. This again is due to his environment and tradition. Nature's processes with which the Village Agriculturist is primarily concerned do not generally need the punctuality of the man of business or commerce. The cow is insured both in Denmark and Switzerland on account of its importance in rural economics. The absence of insurance measures in our villages against crop failures and cattle epidemics, which are by no means uncommon, is largely attributable to the absence of education and business outlook. The villager's income would be both enhanced and rendered steadier by the import of the 'business' mentality into his activities such as agriculture and cattle maintenance.

Outlook on life.—The villager's outlook on the world is often narrow because of the isolation and the absence of literacy. Whether he likes it or not, the villager is being dragged into the world currents of commerce and industry and his horizon needs to be broadened by education. His constant fight with forces of Nature over which he has little control, tinges his ideas with almost fatalism. A bad season too often disproves to him the truth in the saying 'As you sow so you reap'. Industrial activities, on the other hand, are associated with processes which demonstrate the control of natural forces by man and this has a tendency to develop in him certain amount of self-confidence, if not of human pride.

Cottage Industries.

In this study of the Indian village, the villager and village life, we have frequently noticed the need and advantages of industrializing the village. We have found that industries are desirable in the village to find employment for the people all through the year, to stabilize labour, to tone up the villager in various directions and to supplement and steady his income. The large-scale industries, which have developed in the country—while both useful and important for the progress of the country as a whole—have helped the villager but little. On the other hand, they have adversely affected the village tending to draw labour and brains away from the village. What is needed is the establishment of cottage industries in the village itself so as to improve the conditions for living in it.

It is obvious that the closer such industries are linked up with agriculture and agricultural products the better they would fit in with village economics. Cattle being an important adjunct of agriculture, industries like cattle breeding and production of milk and milk products at once suggest themselves. The value of cattle for agriculture is not confined merely to its use as labour, but the trend of recent work is indicative of their playing a very important part as the store house of the right type of manure for crops. The animal and plant kingdoms would appear to be the counterparts of one unit, each benefiting from the waste products of the other. Bee keeping, the poultry industry,

fruit growing and canning and preparation of tinned and infant foods for the benefit of the townsman would fit in well into the village.

Other suitable industries would be the partial preparation of manufactured products in the village itself as a rural industry. Cotton ginneries, seed decorticators and oil presses belong to this group. It saves in the transport of raw material to the central factory, the half-prepared material being generally less bulky than the original raw product. The retransport to the village of the bye-products of manufacture, such as seeds in the case of cotton which are needed back in the village both for sowing and as cattle food, is also thus avoided. Minor industries connected with products or articles available in the village or vicinity, such as cocoanut industry in the West Coast and fish curing in seashore villages, help to keep the villages prosperous.

Other handicrafts and domestic industries, where the needed material is imported from outside and worked in the village during the off-seasons, include weaving, dyeing and the manufacture of toys and trinkets. In spite of technical advances there are yet certain industries which lend themselves to be worked in the villages as domestic industries. The manufacture of toys in the Black Forest regions of Germany, watches in Switzerland, cutlery in Sheffield and little fans, flower baskets and ornamental pieces in Japan are of this class and are a great help in supplementing and steadying the villager's income. The mechanical efficiency obtained in the village as the result of such rural industries gives the village a 'mistry' class who should prove increasingly useful in the repairs and upkeep of farm machinery and water lifting pumps which are spreading in the country.

Co-operative Organization.

The value of organizing on a large scale for increasing efficiency is well known and widely accepted. Most village activities, on the other hand, have by their very nature to be on the small scale and their being grouped together through co-operative organizations is the only remedy. Through them even the small farmer and producer is enabled to command facilities and advantages generally available only to large-scale units. The purchase and sale of articles connected with cottage industries, for instance, need grouping together through co-operative organizations for best results.

Amenities of Life.

As a class our villages lack the conveniences and amenities of urban life. While perhaps certain of these might be considered unnecessary and a few even harmful, there can be no doubt that the bulk of them are in tune with and are necessary for modern progress which is taking hold of the world whether we like it or not. Conveniences like means for rapid transport, the Post and Telegraph, the newspaper and the ever-increasing improvements associated with the development of electricity are major blessings which it is desirable should be extended to the villages as quickly and as completely as possible. It is the absence of these in our countryside that is partly responsible for the prevailing distaste to village life. The village is easily healthier than the town in such important factors as pure air and open spaces and if only certain urban facilities are implanted in the village, its attractions for settlement should prove irresistible.

For permanent results the urge for rural improvement should be implanted in the village itself. This could be achieved only by improving the chief natural agent in such work—*viz.*, the Villager—and making it attractive for him to live and have his being in the village itself. Endeavours that are town centred and take to the village for temporary periods, for lectures, demonstrations or shows—however honest or energetic—have an outside flavour to the villager and do not, therefore, get permanently assimilated into village life.

CONCLUSION.

To sum up, there is little doubt that the villages of old were more populated than they are to-day largely because of conditions prevalent at the time. Those conditions will never return however much or sincerely we may hanker after them. The town and the characteristics associated with urban life are definite products in the march of events and need to be accepted as such. Though there are drawbacks associated with urban life the town has its own good points which need extension into the village to keep rural life in tune with the changes around us. At the same time, the countryside has advantages like open spaces and absence of congestion which can never be reproduced in the town.

Life activities that were village centred in the past are increasingly getting town centred to the disadvantage of the former.

In the interests of the country as a whole relationship of mutual help needs to be established between the two. The town should extend to the village its greater knowledge, quicker living and the manifold amenities of the modern age. Contributions from the countryside are of equal importance. It alone can produce the raw materials of commerce and industry and thus help in the growth of towns and cities. It alone can supply adequate and wholesome food to the millions of our land whether resident in the village or town. Lastly, the countryside alone can imbue the urban 'business' civilization with the deeper character and larger humanities which are nurtured in the villager through his more direct and constant contact with the great forces of Nature and of life. Our duty then is clear: Namely, to improve the *Village*, the nucleus of our country life, and infect its Chief Agent, the *Villager*, with a chosen culture of the virus of modern age through *Education* and *Industrialization*.

Summaries of Addresses of Presidents of Sections.

MATHEMATICS AND PHYSICS.

President: DR. S. DATTA, D.Sc., F.N.I.

ON ABSORPTION OF LIGHT BY ATOMS AND MOLECULES.

ABSORPTION of light by atoms and molecules formed the subject-matter of the Presidential Address by Dr. S. Datta.

He related how the main facts of absorption not only by normal atoms but also by those excited by thermal, electrical or optical stimulus, have all been accounted for by the simple Bohr theory together with the modified selection rules for inter-orbital transitions and the Boltzmann distribution giving the concentration of atoms in the various excited states. Quantum theory is however unable to explain the facts relating to the intensity of absorption lines and this is accomplished by the wave-theory and in a more satisfactory manner by the recent theory of radiation proposed by Dirac.

He next dwelt on the question of the fate of the absorbed energy and indicated the various ways in which the absorbed energy appears to be dissipated according to the facts of observation.

The width of absorption lines formed the next point of his address and he gave the outline of the modern theories of both natural width and its broadening due to pressure.

He next drew attention to the fact that a division of the energy of the photon which follows from the laws of conservation when applied to the processes of exchange of energy between photon and matter is irreconcilable with the phenomenon of discrete absorption according to which the photon energy is indivisible. A mechanism by which Compton effect could be explained without dividing the quant has been suggested.

Dealing with absorption by molecules he discussed the main features of absorption by various types of molecules and suggested that the presence of more than one continuous absorption maximum unaccompanied with bands may as a rule be taken as the chief criterion of an ionic molecule composed of singly ionised atoms and banded absorption with or without continuous absorption those of atomic molecules both polar and non-polar. He then discussed the possibilities of obtaining absorption bands with ionic molecules consisting of doubly ionised atoms and of continuous absorption unaccompanied with bands by atomic molecules, as also the band spectra given by Van-der-waal molecules.

Measurement of the heat of dissociation of molecules from a knowledge of the classifications of the different progressions in the cases of molecules giving banded absorption and from a knowledge of the long wave-length limit in the case of molecules giving continuous absorption were next discussed. In the latter case the use of micro-photograph for finding the limit was strongly recommended. Suggestions were given for the best method of preparing the spectrogram for micro-photographic analysis.

Careful analysis of the continuous absorption records show the presence of several maxima towards the long wave-length limit as first observed by Sommermayer in the cases of alkali-halides. The author's own observations relating to HCl, HBr and NO seemed to confirm the phenomenon and justify the interpretation that the interval between the maxima correspond to the fundamental vibration frequency.

After referring to the phenomenon of pre-dissociation and colours of inorganic salts Datta concluded his valuable survey by indicating some of the important rôles which absorption experiments have played in pure physics as also in industrial and medical problems.

CHEMISTRY.

President: PROF. J. N. RAY, PH.D., D.Sc., F.I.C., F.N.I.

THE CHEMISTRY OF ANTIMALARIALS.

APART from the terrible toll malaria takes annually in the form of human life, its influence on labour inefficiency is a serious factor in the industrial development of the country. In the address the author gives an account of the recent developments in the prevention and cure of malaria by chemicals, in which he and his co-workers have taken an active part.

The relation between chemical constitution and physiological action has a significance in the discovery of new drugs similar to the relation between chemical constitution and colour in the discovery of new dyes. The slow growth of the science of chemotherapy is due to the fact that physiological action has no simple meaning, but covers every action a chemical may exert on the living organism. However, in recent years

considerable progress has been made as evinced by the preparation of new antimalarials and other medicaments.

The physiological action of quinine may be located in (*a*) the quinoline ring, (*b*) the quinoclidine ring, (*c*) the vinyl group. That cinchonine is less effective against malaria than quinine can be explained as due to the difference of solubility of the drugs in erythrocytes, caused by the presence of methoxy group in one. If the ether chain is increased, an improvement occurs as in ethoxy-cinchonine but further lengthening of the chain decreases antimalarial action. Hydrogenation of the vinyl group increases antimalarial action but mere hydrogenation does not produce any antimalarial activity where none is present in the original unsaturated compound. It appears, therefore, that the vinyl group is not directly concerned with the antimalarial action of quinine, though the destruction of the vinyl group and its replacement by a carboxyl group results in total loss of activity, which is regenerated on esterification. Stereoisomerism around the secondary alcoholic group has no material influence on the antimalarial properties of quinine but the replacement of the hydroxyl group by halogen, etc., results in the loss of activity.

From the foregoing summary it would appear that the seat of antimalarial action of quinine is in the quinoline nucleus and that it is augmented by the presence of a secondary alcoholic group. Of the different quinoline derivatives synthesised in recent years, plasmoquine and the Russian product 'plasmocide' have been most successful. Both are gametocidal but have little action on the schizontes. The researches of Fourneau, Robinson and others show that, in compounds of the plasmoquine type with an amino alkylamino group in position 8, greater activity is displayed when the alkyl of the latter group is a straight chain than when it is branched, and that the alkoxy group in position 6 is not indispensable but is always favourable to antimalarial action. The quinine-plasmoquine treatment has been tried on a large scale by the Bengal Government and it appears that it is definitely beneficial.

Mietsch and Mauss have prepared various alkylamino-acridine derivatives of which the substance 'atebrin' has been found to be most valuable. It is less toxic than plasmoquine, from which it differs in that it does not affect the gametes but kills the schizont forms. Thus, it is complementary to plasmoquine. Atebrin used alone is quite sufficient to eradicate the asexual forms of the parasite and hence can effect a clinical cure of malaria. A drug having true prophylactic effect must possess a specific action on the sporozites. Neither plasmoquine nor atebrin, however, possesses this action. A drug having true prophylactic effect has yet to be discovered.

In recent years, an ideal antimalarial has been sought in quinolino-pyrrols by Mrs. Robinson, in glyoxalinoquinolines by Ray and his coworkers. Harmaline has been found to have some curative value in malaria. Ray and his co-workers have prepared pyrryl indoles with partial similarity to the harmine structure. Although the experiments have not yielded positive results, still some purpose has been served in that certain apparently reasonable postulates have been investigated and eliminated. The work of Robinson, Brahmachari and Das Gupta, Chatterji, Seshadri, Kermack, Clemo and others have all been helpful in this respect.

Opium was considered to have a prophylactic value in malaria. This possibility has been investigated and the work so far done, to find a suitable antimalarial amongst the derivatives of narcotine and cotarnine, indicates that it is very unlikely that a potent antimalarial will be found in this series.

Sharp has investigated the alkaloids of *Alstonia* but found both echitamine and alstonine to be valueless.

The recent use of salvarsan, stovarsol and mercuro-chrome in benign tertian malaria suggests that the study of organo-metallic compounds should yield profitable results.

In his address the author has given an account of the recent development of the chemistry of antimalarials and has indicated the possible lines of investigation, which should stimulate further research in this important branch of chemistry. For the treatment of the malaria-stricken masses of the world, a drug is required which is cheap, very efficient and safe. Nothing so far known meets all requirements but the development of active synthetic compounds augurs well for the future and clearly points to the possibility of still better ones being discovered.

The address concludes with an appeal for funds for financing research in the universities. It is hoped that the public will be inspired by the noble examples set by the late Sir T. N. Palit, the late Sir R. B. Ghosh, Sir P. C. Ray and others.

GEOLOGY AND GEOGRAPHY.

President: W. D. West, M.A. (Cantab.), F.N.I.

EARTHQUAKES IN INDIA.

The foundations of the scientific study of earthquakes in India were laid by Dr. T. Oldham and his son R. D. Oldham. The latter will best be remembered for his great memoir on the Assam earthquake of 1897, and for his discovery of the three main types of earthquake waves that are recorded on the seismograph, a discovery that has proved most fruitful in investigations regarding the internal structure of the earth.

The occurrence of earthquakes in India is a legacy of the great earth movements that convulsed the northern flanks of India during Tertiary and Quaternary times, throwing up the Himalayas and the Baluchistan and Burmese mountains. For this reason earthquakes are confined in their distribution to these mountain ranges and to the plains immediately bordering them. By comparison Peninsular India is an area of comparative safety, in which only minor shocks occur.

A detailed analysis of the geological structure of the earthquake belt provides an explanation of the origin of most of the earthquakes occurring within it. In Cutch the subsidence of the coastal tracts beneath the sea is probably the cause of earthquakes in this area. In Baluchistan the re-entrant angle in the alignment of the hills by Quetta and Sibi must be an area of

special strain, and earthquakes are concentrated around it. In Northern India earthquakes probably originate in movement along one of the many thrust faults that have developed as a result of the southward advance of the Himalayan range. In Assam the Assam range, a fragment of Peninsular India, is caught between the converging earth waves from the north and from the east, and has become rent by fault fractures, which are the cause of the earthquakes. Finally, in Burma most earthquakes have been located on one or the other side of the central Tertiary belt, a sunken trough or synclinorium bounded by zones of faulting on either side.

During the present century earthquakes have been confined in the main to three centres of activity—Baluchistan, Assam and Burma—with an occasional disastrous earthquake elsewhere within the danger zone. The Assam earthquake of 1897 was probably the most severe that has occurred anywhere within historic times, though the loss of life was small. But the Kangra earthquake of 1905, the North Bihar earthquake of 1934 and the Quetta earthquake of 1935 between them accounted for at least 60,000 lives.

This disease of earthquakes is a chronic one, but is not peculiar to India. Other countries that suffer from it, such as Japan, California, New Zealand and Italy, have taken steps to combat it, but in India practically nothing has so far been done. It is strongly recommended that a seismological branch of one of the existing services be started, and that research be conducted similar to that done in Japan. The cost of such a branch would be trivial in comparison to the many crores of rupees worth of damage done by a big eqarthuake. In addition, endeavours should be made to imporve the standard of building within the earthquake belt. The value of simple earthquake-proof construction in saving both life and property was clearly demosntrated during the Quetta earthquake. A simple building code should be drawn up by which new construction and town planning in the more important cities of India could be controlled. In addition, more detailed codes should be drawn up in accordance with local needs, and enforced by Provincial Governments and Local Boards.

BOTANY.

President: H. G. Champion, M.A., F.N.I.

THE NEED FOR SCIENTIFIC STUDY OF INDIA'S CLIMAX VEGETATION.

Forest growth still covers about one-quarter of the land surface of India, and if it were not for human settlements and forest-destroying activities, it would undoubtedly cover the whole country with the exception of the excessively dry north-east portions, a few dry tracts in other parts, and the relatively limited alpine areas in the Himalayas which are too high, cold and exposed for it.

It might accordingly be expected that trees both individually and collectively would form the subject of much botanical study in this country which has seen the oldest civilisation in the tropics and is still much the most highly developed tropical country. Even in temperate western countries, very little is yet known about the physiology of the individual tree and still less of the physiology of tree crops, and the life history and problems of the tropical forest are still almost unexplored. In the absence of the needed information, there is a rather dangerous tendency to apply what is known or believed to hold for the temperate forest without proof that such application is permissible.

The interesting problem of the method by which water is lifted to the top of even the tallest trees is almost the only one which has so far attracted much attention. Studies of light quality and intensity under different types of tree canopy and the reactions of the ground vegetation and the regeneration of the overwood trees to variations in these factors are much needed. The absolute water requirements of tree crops in relation to the demands of other types of soil cover are of importance in all irrigated and dry tracts, and call for investigation. Further wide fields for study are offered by problems connected with the secretion of resins, dammars, gums and oils: also those connected with genetical and distribution problems.

Only small beginnings have been made of the study of the tropical forest in relation to the soil, though the great importance of a forest cover especially in the tropics is now generally realised. In its rôle of the great contributor of humus to the soil, it is of the deepest significance to the agriculturist and indeed all humanity, but we still have extremely little precise information on the subject. This reaction of forest on soil is reflected in the succession of forest types which follow one another on new soils which have been and are being laid down by river action and in other ways, providing a most interesting and important field for ecological studies. The professional forester is well aware of the occurrence of such successions but the trained research worker is required to study them in full scientific detail.

The consequences of the maltreatment and gradual opening out or destruction of the forest cover provide the reverse aspect of ecological succession towards the climax vegetation. Such retrogression in many parts of India has gone far beyond mere botanical interest to become an economic problem of first rank importance. Realisation is now rapidly spreading of the causal connection between denudation of forest cover in the hilly tracts and the loss of fertile soil on the slopes by erosion, the overwhelming of valuable agricultural land at the foot of the hills by sand, gravel, and boulders brought down by torrents themselves generated by the loss of the absorbent forest and soil cover,....and also the occurrence of disastrous floods in the plains.

The scientific study of trees and crops calls for a special technique both in the collection and the analysis of data. This is mainly due to the large size of the individual and the space it occupies, and the slowness of its development to maturity and subsequent decay, but complications also ensue from exposure to all kinds of influences, mostly injurious ones from which agricultural crops are more or less protected.

India is in a unique and very favourable position to lead the world in the study of the tropical forest, the problems awaiting solution being full of interest to the scientific worker, and full of importance on their economic side.

ZOOLOGY.

President: Gobind Singh Thapar, M.Sc., Ph.D.

HELMINTHOLOGICAL RESEARCH IN INDIA.

Dr. G. S. Thapar, in his Presidential Address on the "needs and opportunities of Helminthological Research in India" emphasizes the importance of helminthology in medicine, public health, veterinary science and agriculture. He pointed out the indifference with which this science was studied in India, but in recent years there would seem to be a growing appreciation, both by the Government and the Universities, of its importance. The recognition of the work of professional zoologists in India in this connection seems to be a healthy sign, as the past records in other countries reveal the solution of many fundamental problems of helminthology at the hands of the zoologists.

It is true that refinements in sanitation are helpful in the eradication of human parasites: in fact "*Tænia solium* is said to have taken a road to extinction when the mythical Chinaman burned down his house, ate the incinerated pig and pronounced that it was good." But there are great many difficulties in the control of helminths of domestic animals. Limited sanitation, over-population of farm animals, due to greater utilisation of land for agriculture and human habitation, varied means of transportation and climatic factors—all help to increase helminthic infection of the domestic animals. It is, therefore, necessary that investigations should be undertaken on an extensive scale on such problems in an agricultural country like India.

Referring to the ancient history of the subject in India, Dr. Thapar drew attention to the references found in Sûsruta, Charaka and Madhava Nidhana and from these he has identified such worms as *Drimukha* and *Parisarpa* as *Enterobius vermicularis* and *Microfilariæ* respectively under the modern scheme of nomenclature. But very little progress seems to have been made on the subject in ancient India and the doctrine of Ahimsa seems to have played its part in this direction.

Much of the recent information on worms in India is due, chiefly, to the valuable work of certain enthusiastic officers of medical and veterinary services, who, in the course of their routine work, were confronted with worms and this formed the basis of our knowledge of the subject.

Unfortunately, there are great difficulties in providing adequate knowledge of helminthology for our students in India, though the Text-Books in Zoology claim to have been revised and brought uptodate, they still contain old and antiquated nomenclature and classification and these instances are enumerated. Some of these text-books give a confused account of the life histories of even the common worms, like *Ascaris*. This leads to a serious handicap in the treatment and application of preventive measures.

Further, it is desirable to avoid imparting an anthropomorphic outlook of helminthology to the students of zoology, as, in this, the students generally lose all interest in the subject for the rest of their career. A student should study the subject in order to explain the phenomenon of parasitism and for this he should collect helminths from his own dissection animals.

In suggesting the scope of work, Dr. Thapar says that there is considerable field for investigation in the morphology of the worms, as helminth fauna of India still remains unexplored. Even the re-investigation of the described forms seems to offer ample scope of work, as errors in diagnosis are perpetuated in the recent literature on the subject. Illustrations are given from the work of various authors to show the justification of re-investigation of even the described forms. The chief problem in helminth morphology today is the elimination of errors which unfortunately have crept into the earlier literature.

The accurate morphology and natural classification would answer the problems of relationship and evolution of the group and numerous illustrations cited have been collected from the work of Dr. Thapar and his colleagues at Lucknow.

The solution of life histories will greatly facilitate the control measures and Leiper's work on the Schistomiasis in Egypt amply justifies further work on similar lines. The recent discovery of *Echinococcus* cysts at Lucknow simulating *cœnurus* cysts seems interesting and promises fresh fields for experimental investigations.

The question of host specificity is also discussed and conflicting observations by prominent workers are indicated to show the necessity of further investigations on the subject. The question does not seem to be a settled one.

Considering the pathogenic effects of helminths, Dr. Thapar made references to the recent demonstration of *Enterobius vermicularis* as a cause of appendicitis in man and this has awakened interest for the study of the diseased condition, particularly in animals. The discovery of *Schistosoma spindalis* as a cause of "Nasal granuloma" of cattle, commonly known as snoring disease in India and the recent investigations on the etiology of "Barsati" of equines, showing *Habronema* larvæ in the affected parts of the animal's body are illustrations to indicate worms as cause of disease in animals. Both these animal diseases were believed to be of mycotic origin and these discoveries mark a new era in the disease investigation of animals in India.

There are a large number of anthelmintics used for the removal of worms but a considerably larger number prescribed by Hakims and Vaids, claim specificity for particular kinds of worms. Chopra has investigated many of these indigenous drugs for their action but a majority of them still need verification. The crude method of administration of certain plant products, like the juices of *Blumea lacera* (kukronda) as local application and otherwise against the common pinworm of man by laymen offer fresh field in the study of drug administration in their natural condition, particularly for the domestic animals. The effect of yeast and vitamins on the immunity problems forms a necessary adjunct to such investigations, as it would be desirable to obtain parasite-resisting strains of animal population that would be better fitted in the struggle for existence.

The production of pearls inside the molluscan

shells is said to be due to the presence of helminth larvæ and for this, growth of such larvæ may be encouraged. This is an aspect of helminthology that demonstrates its utility to man.

In view of such opportunities of varied nature offered by the study of helminthology in India, and its growing significance in different spheres, emphasis must be laid on the necessity of co-operation amongst workers in different fields—medical, veterinary, public health and agriculture—so that we may be better able to combat the problems and obtain most satisfactory results. The experience of such a work in other countries amply justifies such a line of action in India. Let us, therefore, stimulate interest in the study of helminthology, so that by patient interest and diligent application we may help in the solution of various problems connected with helminthological research and thus establish an active school of helminthology in India.

ANTHROPOLOGY.

President: DEWAN BAHADUR L. K. ANANTHA KRISHNA IYER, B.A., L.T., M.D. HONS. (Bres.).

AN ETHNOGRAPHICAL STUDY OF THE COORGS.

DEWAN BAHADUR DR. L. K. ANANTHA KRISHNA IYER reviewed the progress of anthropology during the past 24 years in his Presidential Address.

The principal subject of his address was an ethnographic study of the Coorgs. The writers who had made an intensive study of the Coorgs differ in their conclusions, and Coorg inscriptions throw very little light on the early history of that interesting community. The province was successively connected with the Kadambas, Ganga Dynasty, Hoysala kings, Nayaks of Belur under Vijayanagara rulers, the Lingayat rajas of Coorg as also those of the Bednore family. Further the Coorg rajas were themselves aliens. Wynad Chetties have their settlements in Coorg as their house names testify. From all these facts it is conjectured that the Coorgs are not without a racial admixture from a remote period. There is also a great deal of culture contact between the Coorgs and the people of Malabar, Canara and the Tamil districts, and the Tulu population. Their language is a mixture of the Dravidian languages. The physical traits are biologically useful, and related to mental capacity and intellectual endowment. Applying this maxim to the Coorgs, their mountain habitat, climate, food and occupation have largely made them what they are at present. It is interesting to note that these factors have differentiated them from the people of the plains.

Dr. Iyer next dealt with the economic life of the Coorgs who were first hunters and fishers, and then agriculturists. Their hunting propensities are still seen in their festivals, and their primitive weapons are being gradually replaced by modern guns and spears. Fishing is generally carried on in streams and paddy fields during the rainy months. Agriculture of the Coorgs which is of the rudest kind, is similar to that which prevails in other parts of India. It is a system of rural economy formed at a remote period and transmitted for ages unchanged. The cultivator is attached to the ancient practices, and views with dislike any attempts at innovation. Industry of the people of the highlands is confined exclusively to the cultivation of rice. The narrow valleys between two high grounds are very productive. The agricultural implements are few and of the rudest kind, and yet the yield has furnished an unfailing supply from ancient times both for consumption and export to Malabar. Wherever possible, the valleys have been formed into flat terraces for cultivation.

The agricultural year, as in other parts of South India, begins about the middle of April, *Chaitra Sankranti*. With the first shower in April or May, the ploughing commences. On an auspicious day before sunrise the house lamp which plays a conspicuous rôle on all festive occasions, is lighted in the inner verandah when the members of the family assemble and invoke the blessings of their ancestors and Cauvery Amman (River Deity). The young men make obeisance to their elders, and drive a pair of bullocks to the paddy fields. The landlord now offers cocoanuts and plantains, rice and milk to the presiding deity of the *nad* (division of the district) lifting up his hands to the rising sun, and invoking his blessing. The oxen are yoked and three furrows are ploughed when the work is finished for the morning. Of the upturned earth, he takes a clod to the store house or granary, offers his prayers to Siva to grant him an increase of one hundred times. From 6 to 10 A.M. the ploughing continues till the fields are turned two or three times. Then the borders are trimmed, and the little banks repaired to regulate water. After this, sowing, transplanting, weeding, and finally harvesting are in operation. Before the completion of transplantation of the largest field, an open space of 10 feet wide is left throughout the whole length, to provide the Coorg race-ground offering a jolly good sport amidst their monotonous work.

To a large number of Coorgs, cultivation of coffee, cardamoms and fruits are important industries. The Coorgs are fond of honey gathering. It is a domestic industry. The Coorgs have an abundant supply of food materials. They rear pigs and goats. Their chief article of diet is rice and on festive occasions cakes and sweetmeats are also prepared. The Coorg hospitality is proverbial. The Coorg houses like those of the Nayars are generally situated close to their paddy fields on a sheltering slope of Bene land surrounded by columns of plantain trees, sago palm, betelnut palms, orange, jack and gauva trees. A coffee and a small kitchen garden are seldom absent. In the compounds of some houses there is a small pond well stocked with fish. The buildings very much resemble those of the Nayars of Malabar and the approaches of the old Coorg house mark the design of fortification. The tradition points back to the time of general feuds when chief fought with chief and clan with clan. Deep kadangas or trenches with high embankments still testify to the memorials of their warlike state of affairs in former times. The furniture of a Coorg house bear ample testimony to the simple habits of the inmates. The Coorgs are a hardy race and bear with fortitude much hardship especially during the monsoon months when they are engaged in cultivation. Exposed to all the inclemencies of the weather they retain their vigour, most admirably. Their

dress and ornaments are peculiar. Their marriage regulations are a curious medley of old and new rites, fashions and notions. In former times their marriage festivities had a communal character. Marriage is adult and has some of the formalities of the Hindu ceremonies. The Coorg family is joint and patriarchal. There is not a single family affair of any importance which may not be undertaken without the consent or knowledge of the senior member. The senior female member is the queen of the household. Their public morality is controlled by a council of elders, and they are the moral censors and managers of all social matters without any material help from the Government. The offenders are punished with fine or excommunication. The Coorgs are animists and have their ancestor and demon worship. They have been influenced by the Malayali, Tulu, and recently by Canarese Brahmanical and Lingayat superstitions. The Tulus have introduced their demons and ancestors worship, and their services are often requisitioned. They worship *Cauvery Amman*, and their chief festivals are *Huttari* corresponding to the *Onam* festival of Malabar and Kaylmurta.

AGRICULTURE.

President: Rao Bahadur B. Viswa Nath, F.I.C., F.N.I.

SCIENCE AND PRACTICE OF AGRICULTURE IN INDIA.

Rao Bahadur B. Viswa Nath, Imperial Agricultural Chemist and Officiating Director, Imperial Agricultural Research Institute, New Delhi, presiding over the Agricultural Section of the Indian Science Congress, spoke on "Science and Practice of Agriculture in India". He reviewed the progress of agricultural research in India with reference to agricultural practices in the country, and directed attention to some important problems. The address is, in the main, an analysis and synthesis of the existing data from the laboratory and the field, which leads to the important issue, namely, the building up of the soil. He said that Indian soils and agricultural practices were several centuries old and that research should and was concerning itself more with the details of existing practices than with the evolution of wholly new methods, whose success was doubtful, and said that the aim of research was to build up on the existing system a state of agricultural practices suited to the conditions of the soil and the resources of the cultivator, who was always ready to take up any improvement suited to the conditions with which he was faced.

Speaking of the work on soils, Mr. Viswa Nath said that the aim was to maintain the high productivity of the soils that were already rich, to restore to normal, those soils whose productive capacity was impaired, and to increase the yield of soils which were originally poor. He referred to the scientific studies directed to the attainment of these objects, discussed the important differences between Indian and European soils, explained the lack of success, in India, in the application of many of the results and practices found suitable in those countries and stressed on the necessity for a different outlook on the applied aspects of soil science particularly with reference to arid and semi-arid soils of the country.

The Rao Bahadur then discussed the work on manures and fertilisers during the past quarter of a century and said that the evidence clearly established the importance and suitability of organic manures to Indian soils. In regard to fertilisers, he said that the theoretical possibilities of artificial fertilisers were almost limitless but that their achievement on Indian soils was limited by the organic matter supply to the soil and pointed out the necessity for husbanding our resources of organic manures and for utilising them to the fullest extent possible. He drew pointed attention to the evil consequences of intensive cultivation and the intensive use of fertilisers without the necessary accompaniment—namely organic matter and organic manures. Organic matter was the life of the soil and if organic manures were neglected we should be doing four things. Firstly, the fertility of the soil would not be maintained, secondly, artificial fertilisers would not be used to the fullest advantage, thirdly, the cropping power of the improved seed would be reduced and fourthly, the nutritive value of food crops would be low.

Rao Bahadur Viswa Nath finally referred to problems of food and nutrition and discussed the problem both from the point of view of quality and quantity and said that in both these directions soil conditions played a prominent part. He referred to his own work and that of McCarrison on the subject and said that manuring contributed to the nutritive value of the crop and in this respect organic manures were the best in endowing a crop with a high nutritive value. In regard to quantity, the Rao Bahadur showed by calculations that our present production of food crops was enough for the proper feeding of only two-thirds of the population and that there were considerable scope and possibilities for increasing production. This he said depended on the building up of the fertility of the soil and pointed out in the address the ways and means of doing it.

PHYSIOLOGY.

President: Lt.-Col. S. L. Bhatia, M.C., M.A., M.D., F.R.C.P., F.R.S.E., I.M.S.

PHYSIOLOGY IN INDIA.

In India as elsewhere, the history and growth of Physiology were inseparably connected with those of Medicine. Medicine had been practised and taught in India from times immemorial. The system of Medicine indigenous to the soil was the Ayurvedic. Subsequently the Unani or the Greaco-Arabian system was introduced, which had developed under the enlightened patronage of the Khalifas of Baghdad. Then he described the steps that led to the introduction of Modern Medicine and Physiology into India. This movement started in the early part of the nineteenth century. At this time, instruction in Ayurvedic and Unani Systems of Medicine was imparted in the Sanskrit College and Madrassa in Calcutta. In 1822 the first Medical School was established in that City. A similar Medical School was established in Bombay in 1826, but after functioning for six

years was abolished in 1832. It was to Lord William Bentinck, the Governor-General, that the credit was largely due for initiating higher medical education in India. For improving the Medical School in Calcutta, he appointed a Committee in 1833 whose deliberations have had a most profound effect on the future course of Medical Education in India. Lt.-Colonel Bhatia then briefly described the origin of the Medical Colleges in Calcutta, Madras and the Grant Medical College, Bombay, the three oldest Medical Colleges in India, where the teaching of Modern Medicine and Physiology first started. Subsequently numerous other Medical Colleges and Schools were established. With the increase in the number of these institutions there resulted a marked expansion of Medical education. And side by side with this, the knowledge of Physiology also spread.

Physiology in Europe.—In order to furnish a correct perspective to the position of Physiology in India, Lt.-Col. Bhatia made a rapid survey of its development in Europe and especially Great Britain.

Physiology in India: The Future—Physiology had a brilliant future in India. There were many problems in the solution of which the guidance and help of the Physiologist were indispensable.

(*a*) *Physiology and Social Service.*—Laboratory Physiology is not an end in itself, but a means by which we can understand the larger problems of life, and specially human life on this earth. It was a melancholy fact that in proportion to the knowledge of Physics and Chemistry the knowledge of Biological Sciences in the country was comparatively meagre. And yet in considering ways and means to bring about social reconstruction, and physical well-being of the people, a knowledge of Physiology was indispensable.

(*b*) *Nutrition.*—The subject of bodily nutrition was the special domain of the Physiologist. During the last 25 years or so, very important investigations had been carried out, in the field of the qualitative side of dietetics, specially the biological value of different proteins of animal and vegetable origin, and of the special significance of the mineral constituents of the diet and vitamins. The subject of nutrition in India needed to be investigated from many points of view. To the Physiologist it offered great opportunities for original research work. He trusted that many workers would be attracted by it, for, the knowledge thus gained would be of direct benefit to our countrymen.

(*c*) *Racial and Anthropological Physiology.*—There was a tendency amongst workers in India to investigate normal physiological constants. This information was of the utmost value, as it would indicate any differences that might exist when compared with data from European countries. It would throw light on any racial or environmental variations that may occur. We should thus have a basis for Racial or Anthropological Physiology, an important branch of Human Physiology, which had not received sufficient attention hitherto.

(*d*) *Adaptation to Tropical Climate.*—Another fruitful line of physiological investigation was to ascertain the factors concerned in the adaptation to tropical conditions. Undoubtedly here, as elsewhere, the famous dictum of Claude Bernard 'La Fixite du Milieu interieur est la condition de la vie libre' held good. These were some of the problems jotted down at random that could be taken up for investigation.

Physiology in the Medical Curriculum.—In the pre-clinical group of subjects Physiology occupied a position of the first rank. There had been a great deal of discussion in recent years in England and elsewhere regarding the scope and function of this pre-clinical instruction. The wide gulf that separates the pre-clinical and clinical sciences should be bridged and there should be continuity of instruction in pre-clinical sciences in the clinical years.

Concluding Remarks.—In order to escape from empiricism and legitimately to claim the status and dignity of a science, Medicine must have Physiology as its basis. But Physiology had other aims of its own. Some of the greatest discoveries in Physiology in recent years had been made by men who had no medical training whatever. It had flourished most in those Universities where it had led an independent existence like Physics and Chemistry. Although the ultimate aim of all Sciences is the welfare of mankind—and this is perhaps true more of Physiology than any other science—the immediate aim of any scientific endeavour must be the discovery of *truth*, irrespective of its possible applications.

In conclusion, Lt.-Colonel Bhatia said that the two greatest needs of the hour in the scientific world in India were to have more scientific workers of first class ability, and to have harmony and good-will amongst them. Gatherings such as these, apart from promoting scientific discussions and advancement of Science brought about unity and friendship amongst the workers. They established such contacts as were not possible in any other way. He hoped that the section of Physiology would promote solidarity and cordial relations amongst all the Physiologists in India. Thus, Physiology will make a great headway, and its progress will be a pride to us all. 'Let us, therefore, march forward and fulfil our mission of serving Physiology with faith, hope and charity, with faith in the ultimate benign aim of our science, with hope which will strengthen all our efforts, and with charity in which as men of science to be worthy of our vocation, we must live, move and have our being.'

PSYCHOLOGY.

President: K. C. MUKHERJI, M.A.

THE SOCIAL MIND OF THE INDIVIDUAL.

SOCIAL relations are essentially mental. In the individual's mental life some one else is invariably involved. There are not at first individuals and then a social unity, as there might be bricks and then a pile of them.

Some believe that collective consciousness is the highest form of psychic life, and society is the real god. Any alleged superiority of social mind can hardly as a rule be maintained. If a wave of emotional agitation sweeps through the group each may become less than himself, less critical and more suggestible. There is a

considerable tendency to change one's opinion as a result of discussion, but it is experimentally observed that the females profit more by this discussion than the males. We observe practically that the number of jurors is increased to decide cases of murder while to keep the look-out for the safety of the ship only one man, and not ten, is employed. The weight of responsibility is divided among the members of the group and weakened in proportion for each man. But for this diminution of this sense of responsibility man can hardly condemn another to death. The group or committed decision is sometimes altogether irresponsible and may only be an intellectual necessity to avoid the crushing weight of high individual responsibility.

Social consciousness follows almost a cyclic order of development. The individual is more a social outcome than a social unit. The child is not an individual when he enters into the society but he grows into an individual by social interaction. The outline of the individual gradually appears, and at every stage it shows the pattern of the social culture of which he becomes a specification. The social culture in the last analysis comes from the individuals themselves. So individuals should be not merely static conformists to, but creative artists of culture. A non-creative personality or a culturally passive mass is a failure, educational as well as social. So the political or legal organisation should have only secondary value as existing for the sake of cultural institution and activity.

The consciousness of the family group prepares the child's mind for and accentuates the development of wider group sentiment. The family sentiment and the national sentiment are equally strong in Scotchmen especially the Highlanders. The family sentiment is very keen among the Japanese who are also noted for their high national spirit. This is also true of Germany and Italy. The people of East Bengal are noted for their national outbursts, but their sentiment for joint family system is also highly remarkable. Although any vital connection can hardly be established in view of the low sense of nationality possessed by primitive people in spite of intense family sentiment, but still the importance of the mental effects of the family life in relation to the foundation of national sentiment should be no less insisted on than the importance of the organisation of the family life for the material welfare of the State, and it is probably true that any barrack system of rearing up State children, if introduced, would be disastrous to the growth of national life. There is no reason to find in the family a natural menace to the development of wider social feeling. Unless narcissistically fixated and concentrated the family sentiments aid rather than impede the development of higher social sentiments.

Peoples are greatly moulded by their physical environment. In India the astounding magnitude of the objects and the appalling character of the devastating forces of nature stimulated the uncritical minds of the people into grotesque fancies which probably led them to portray gods with many arms, three eyes and terrible visages.

There is some evidence that the crossing of closely allied stocks does conduce to increase of vigour and energy of mind and body and also to the variability of the stock for the production of persons of exceptional gifts. The Chinese have a high average ability and are a relatively pure race but their culture has stagnated for want of men of exceptional capacity. So the rigour of the exclusive caste system for the maintenance of the purity of blood is not biologically sound. But the crossing of the widely different stocks is supposed to produce an inferior race. So the Eurasians of India are said to be of a comparatively poor race. But any universal characterisation of the Eurasians is risky when the unit qualities of the parental stocks are not blended and the individual of a blended stock is a mosaic of such unit character.

Semmer concludes that social or racial prejudice is based on recognition of differences, but prejudice simply because of differences does not exist. There is no feeling of hatred between the Spaniards and Indians in spite of differences in colour, speech, habits and dresses. The difference is only an element in the total situation, sometimes it may be the symptom and not the cause of the disease. The main determinant consists in the baulked impulses of the politically, economically and culturally dominated group. Differences are emphasised because they offer the readiest rationalisation for defence against real or fancied dangers. It is for the accentuation of the dynamic relation that the Hindu-Muslim tension exists. The policy to multiply such relations of a group with different groups is destructive of its vitality. When any tension occurs the reaction may aim at the immediate extermination of the threatening force for the restoration of the inter-group equilibrium, but history shows that men cannot be made to change their opinion by direct coercion. This is an instinctive mode of reaction in which the end is directly aimed at and is characteristic of the lower order of animal behaviour. Reason works through stratagem in a round-about way. The strategy that reason is to employ in liquidating the baulked impulse of social prejudice should be far remote from the end and will prove efficient in proportion as it operates unconsciously of the goal. This very remoteness of the measure of the social process is the cause of its great efficiency. This is somewhat of the nature of a weight the power of which, when thrown on the longer end of a lever, is multiplied in transmission. Gandhiji's Satyagraha movement to stop the drinking habit of the masses fails because of its very clear and direct attack upon the end. Improvement of conditions, introduction of good music, drama, education, etc., would, however slowly, have produced a more stable effect. So legislation often fails to effect social amelioration. In flattening a warped iron-plate strokes are to be judiciously administered first outside the warped part otherwise new defects would be produced. Should we think that humanity can be more readily straightened than even an iron-plate?

LETTERS TO THE EDITOR.

CONTENTS.

On Bayes' Problem.

Following Karl Pearson[1] we will consider the famous problem of Bayes in the form below.

An "event" has occurred a times out of $a + b = c$ trials, where we have no *a priori* knowledge of the frequency of the event in the total population of occurrences. What is the probability of its occurring d times in a further $d + e = f$ trials?

Various solutions of this problem, which are, however, not entirely satisfactory, have been given. The following solution appears to be the most satisfactory among those given so far.

We shall call the occurrence of the event a success. Let the probability of success of the event in the total population of trials be p. Then the chance that there will not be more than a successes in c trials is given by

$$P = q^c + {}_cC_1\, q^{c-1}\, p + \cdots + {}_cC_a\, q^b\, p^a \qquad (1)$$

where $q = 1 - p$, and $c = a + b$.

Equation (1) is of the cth degree in p. Hence when solved for p we will get c roots. It can, however, be easily shown that *there is only one root which is between* 0 *and* 1. We shall consider here only this solution of equation (1).

Let us take some level of significance, say 0·05. Putting $P = 0{\cdot}05$ in (1) we solve for p.* Let p_1 be the solution. This means that if p has a value greater than p_1, the chance of obtaining not more than a successes in a random sample of c trials is less than 0·05. Hence on our level of significance our sample of c trials of which a are successes could not have been obtained from a population in which the probability of success is greater than p_1. Thus p_1 is the higher limit of p.

Similarly the probability of getting not more than b failures in c trials is

$$P = p^c + {}_cC_1 p^{c-1}\, q + \cdots + {}_cC_b\, p^a\, q^b \; (2)$$

Putting $P = 0{\cdot}05$, we solve (2) for p. Let p_2 be the solution. In a manner similar to the above we can see that p_2 is the lower limit of p.

Hence on our limit of significance

$$p_2 < p < p_1 \qquad (3)$$

If p_1 be the probability of success in the population, then the chance of obtaining d successes in f trials is

$$P_1 = \frac{f!}{d!\; e!}\, p_1{}^d q_1{}^e, \text{ where } q_1 = 1 - p_1,$$

$$\text{and } d + e = f.$$

Similarly, if we assume p_2 as the probability of success in the population, the chance of getting d successes in f trials is

$$P_2 = \frac{f!}{d!\; e!}\, p_2{}^d q_2{}^e, \text{ where } q_2 = 1 - p_2.$$

Thus the chance, P, of obtaining d successes in f trials when it is known that in

* The method of solution is given in the fuller paper to be published shortly.

previous e trials there have been a successes, is given by

P lies between P_1 and P_2 (limits included) .. .. (a)

or

P_1 or $P_2 < P < P_3$, retaining the smaller of the two P_1 or P_2, where

$$P_3 = \frac{f!}{d!\ e!}\, p_3{}^d\,(1 - p_3)^e, \text{ and } p_3 = \frac{d}{f} \qquad (b)$$

(a) is to be used when p_3 is outside the interval from p_1 to p_2, and (b) when p_3 is within the interval p_1 to p_2, including the limits.

More details will be found in a paper to be shortly published.

S. R. SAVUR.

Poona 5,
December 21, 1936.

[1] Karl Pearson, *Biom.*, 1920-21, **13**, 1-16.

Absorption Spectra and Photo-dissociation of Simple Organic Molecules.

RECENTLY it has been shown,[1] that the photo-dissociation of polyatomic molecules formed by atoms of groups V and VI of the periodic table follows different lines according to the state of valency of the central atom. In a lower state of valency, *i.e.*, as long as chemical combination is brought about by the p electrons of the central atom the bond energies are decisive for the photolytic process. In the state of maximal valency involving the activation of the two electrons of the s^2 group, the thermochemical difference between the atomic energy of formation of such a molecule and the corresponding one of lower valency determines the decomposition by light. Since according to the view of the pair bond theory of valency the unexcited carbon atom is divalent only and becomes tetravalent only by an excitation which involves the activation of the s^2 group, we have reinvestigated the absorption spectra and photo-dissociation of a number of halides formed by atoms of group IV and find indeed, that the same view is confirmed there too.

The first photo-dissociation of, *e.g.*, methyl iodide is not represented by the process $CH_3I \rightarrow CH_3 + I$, but by $CH_3I \rightarrow CH_2 + H + I$. The dissociation products are an iodine and a hydrogen atom, and a CH_2 molecule, which is not a radical but a saturated molecule like $SnCl_2$ or $PbCl_2$. The absorpion spectrum corresponds to a transition from the ground state of CH_3I to that repulsive curve which is produced at decreasing internuclear distance by the system $CH_2 + H + I$ on account of the rigorous divalency of unexcited C (*i.e.*, the lack of free valencies in unexcited CH_2).

The simultaneous splitting off of two atoms of simple organic molecules receives confirmation by the following experimental results :—

(1) In the case of $SnCl_4$, the only one for which all thermochemical data are available, the long wave limit[2] corresponds to the energy difference $D(SnCl_4) - D(SnCl_2)$.

(2) We estimate the dissociation and bond energies of the molecules CH_2, CHX, CX_2 (X = Cl, Br, I) from the atomic energies of dissociation of CH_4 and CX_4 according to the known ratio $D(SnCl_4) : D(SnCl_2) = 5 : 3$. Using these values, we find that the beginnings of the first selective absorption of the twelve alkyl halides investigated are in agreement with the energy differences $D(CX_4) - D(CX_2)$, $D(CHX_3) - D(CHX)$, etc.

(3) Wherever the whole of the selective absorption falls into the quartz ultraviolet, we find three regions of selective absorption whose long wave limits and maxima are of the order of the energy difference $^2P_{3/2} - {}^2P_{1/2}$ of the halogen atom provided the molecule contains a sufficient number of Br or I atoms such as $SnBr_4$, CI_4, CHI_3, etc. They correspond obviously to the photolytic processes $CX_4 \rightarrow CX_2 + 2\,X\ (^2P_{3/2})$, $CX_4 \rightarrow CX_2 + X\ (^2P_{3/2}) + X^*\ (^2P_{1/2})$, and $CX_4 \rightarrow CX_2 + 2X^*\ (^2P_{1/2})$. The existence of the third maximum due to the simultaneous excitation of two halogen atoms appears to exclude any other explanation.

These results promise to lead to an experimental determination of the bond energies of organic molecules; thus the C – H bond in the saturated molecule CH_2, formed by divalent carbon, has 114 K.cal/mol. They also show that a fundamental change in the interpretation of the photo-dissociation of many organic molecules is necessary. Incidentally they show directly that the unexcited carbon atom is divalent only, in accordance with the pair bond theory of valency. They fall into line with certain results and considerations of Mecke Norrish,

Terenin, a. o. A detailed report will be given elsewhere.

Y. P. PARTI.
R. SAMUEL.

Department of Physics,
Muslim University, Aligarh,
December 15, 1936.

[1] R. K. Asundi and R. Samuel, *Proc. Phys. Soc.*, 1936, **48**, 28; Mohd. John Khan and R. Sammuel, *Ibid.*, 1936, **48**, 626; S. L. Hussain and R. Samuel, *Curr. Sci.*, 1936, **4**, 734.

[2] The first absorption region, recorded by R. S. Sharma (*Bull. Ac. Sci. Allahabad*, 1933, **3**, 87) is due to Cl_2.

The Spectrum of Argon IV.

THE spectrum of a condensed discharge through argon gas was photographed in the visible and the quartz regions at various stages of excitation and the lines due to A IV isolated. The data thus obtained led to the discovery of several regularities in the lines. The following table gives some of the 4p terms and in the second column their probable identification is indicated.

Term	Identification
289244	4p $^4D_{1\frac{1}{2}}$
289765	$^4D_{2\frac{1}{2}}$
291430	$^4P_{\frac{1}{2}}$
291750	$^4P_{1\frac{1}{2}}$

It may be remarked that there is entire agreement between the present identification and some of the terms previously reported by Boyce,[1] who worked in the Schumann region. The complete scheme will be published shortly.

S. G. KRISHNAMURTY.

Science College,
Waltair,
November 17, 1936.

[1] J. C. Boyce, *Phys. Rev.*, 1935, **48**, 396.

Crystal Structure of Hydrazobenzene—The Space Group.

FROM the crystallographic measurements, the crystals of hydrazobenzene are known to belong to the orthorhombic bipyramidal class. The axial ratio is

$a : b : c :: 0{\cdot}9787 : 1 : 1{\cdot}2497.$[1]

Rotation photographs taken about the three crystallographic axes give the following values for the dimensions of the unit cell

$a = 7{\cdot}35$ Å, $b = 7{\cdot}50$ Å, $c = 18{\cdot}75$ Å.

The axial ratio obtained from these agrees very well with that given in Groth except that $(c : b)$ is doubled.

A number of oscillation photographs were taken about the b and the c axes at suitable intervals. From the reflecting planes identified it is found that (hol) planes are halved when (h+l) is odd, (okl) planes are halved when (k+l) is odd, and (hko) planes are halved when (h+k) is odd. These halvings correspond to the space group Q_h^2. Also all (hkl) planes are halved when (h+k+l) is odd. This shows that the lattice is a body-centred lattice. Banerji and N. M. Saha[2] have recently published some results on the arrangement of benzene rings in crystals of hydrazobenzene and they have assigned, contrary to our results, the space group D_{2h}^5 (Q_h^5 in our notations).[3]

The space group Q_h^2 requires eight asymmetric molecules to complete the symmetry of the cell. The number of molecules (mol. wt.—184) calculated from the above dimensions and the specific gravity of the crystals (found to be $1{\cdot}18$) is only four (accurately $3{\cdot}99$). This indicates the presence of some symmetry in the molecules of hydrazobenzene and these may be (i) axis of symmetry parallel to the a, b, or c axis, or (ii) a centre of symmetry. Crystals of hydrazotoluene are also being studied and the details of the structure of both crystals will be published elsewhere.

JAGDISH SHANKER.
MATA PRASAD.

Chemical Laboratory,
Royal Institute of Science,
Bombay,
January 12, 1937.

[1] *Cf.* Groth, *Chem. Krystallg.*, 5, p. 59.

[2] *Abstracts of Papers*, Mathematics and Physics Section, Indian Science Congress, Hyderabad Session, 1937.

[3] Astbury and Yardley, *Phil. Trans.*, A, **224**, 221.

Resolution of Bi*cyclo*-(2 : 2 : 2)-octane-2 : 5-dione-1 : 4-dicarboxylic Acid.

THE synthesis of bi*cyclo*-(2 : 2 : 2)-octane-2 : 5-dione-1 : 4-dicarboxylic acid, starting from succinosuccinic ester has been reported by one of us,[1] and it was thought that a resolution of the acid would, in addition to its intrinsic interest, offer an additional proof as to the correctness of its constitution. For this purpose the acid was combined with

brucine (2 molecules) when a salt separated. Specific rotation of the brucine salt after five recrystallisations $[\alpha]_D^{260 \cdot 5} \rightarrow 70 \cdot 87$ (C $= 2 \cdot 25$ in pyridine). The acid liberated from the salt had $[\alpha]_D^{25°} = + 23° \cdot 85$ ($l = 1$; C $= 2 \cdot 13$ in water). The mother liquor (of the brucine salt) yielded on three successive evaporations and filtrations the pure salt of the *l*-acid which when liberated free had $[\alpha]_D^{280 \cdot 5} = - 23 \cdot 24$ ($l = 1$; C $= 0 \cdot 90$ in water). In the same thermometer the inactive, *d* and *l* forms melted at 268°, 271° and 271°, respectively.

P. C. GUHA.
S. K. RANGANATHAN.

Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
December 17, 1936.

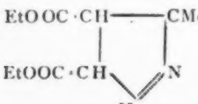
[1] *Curr. Sci.*, 1936, **5**, 9.

A New Method of Synthesis of Caronic Acid and Homocaronic Acids.

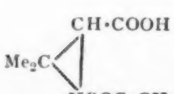
CARONIC ACID (1 : 1-dimethyl*cyclo*propane-dicarboxylic acid), the ultimate degradation product of a number of naturally occurring bicyclic compounds, *e.g.*, carone, Δ^3- and Δ^4-carene has been synthesised by Perkin and Thorpe[1] from ethyl α-bromo-$\beta\beta$-dimethyl-glutarate, by Kotz[2] from ethyl *iso*propylidene dimalonate and by Kon and others[3] from Guareschi-imide.

Although diazomethane and diazoacetic ester have found application in the synthesis of some monocyclic and bicyclic derivatives of compounds of the thujane group,[4] no synthetic investigation seems to be on record in which dimethyl-diazomethane has been used for such synthesis.

Dimethyldiazomethane has now been found to react with ethyl fumarate and maleate at a temperature of about $-18°$ C. to give the pyrazolone derivative (I) which when heated to about 240–50° loses nitrogen yielding ethyl *trans*-caronate (b.p. 240°) as the primary product. This ester yields *trans*-caronic acid (II) on hydrolysis with 5% KOH on water-bath.



(I)



(II)

The product obtained after crystallising twice from water melted at 213° ; mixed melting point with a genuine sample of *trans*-caronic acid remained undepressed. The acid obtained from the mother liquor on treatment with acetic anhydride at 220° in the usual manner gave *cis*-caronic acid m.p. 175°. It is interesting to note that ethyl maleate also gives *trans*-caronic acid under identical conditions ; evidently the *cis*-variety is unstable under the conditions of the experiment (*cf.* Formation of *trans*-caronic acid from Δ^3-carene by oxidation).[5]

Dimethyldiazomethane reacts similarly with diethyl glutaconate to yield finally homocaronic acid which has been recently synthesised by Owen and Simonsen[6] from ethyl Δ^β-*iso*hexenoate.

The action of dimethyldiazomethane is being tried with a number of other suitable unsaturated compounds with a view to synthesising carane and other compounds of the carane group.

P. C. GUHA.
D. K. SANKARAN.

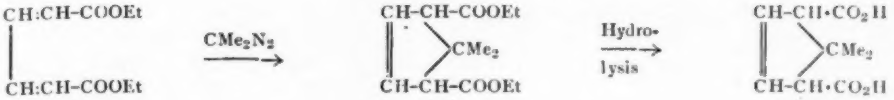
Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
December 9, 1936.

[1] *Soc.*, 1899, **75**, 56-57.
[2] *J. pr. Chem.*, 1907, (2), **75**, 501.
[3] *J. C. S.*, 1921, **119**, 1322.
[4] *Proc. Ind. Sci. Cong.*, Presidential Address (Chemistry Section), 1936, p. 146 ; Philips, Ramage and Simonsen, *J. C. S.*, 1936, 828 ; Rydon, *J. C. S.*, 1936, 829 ; Ranganathan, *J. Ind. Chem. Soc.*, 1936, **13**, 419.
[5] Gibson and Simonsen, *J. C. S.*, 1929, 305.
[6] *J. C. S.*, 1933, 1225.

A New Method of Synthesis of *Iso*-dehydroapocamphoric Acid.

*ISO*DEHYDROAPOCAMPHORIC acid (III) was synthesised by Komppa[1] starting from dimethyl glutaric ester *via* ethyl oxalodimethyl-glutarate (diketoapocamphoric ester) and dihydroxyapocamphoric acid.

As the first experiment tried on the possibility of formation of *cyclo*pentane compounds by the action of dimethyldiazomethane upon butadienes containing a system of conjugated double bond, the diazo compound has been found to add up to diethyl muconate (I) to yield diethyl *iso*dehydroapocamphorate (II). The ester (II), b.p. 200°/100 mm., gives on hydrolysis the corresponding acid, m.p. 208–209° (Komppa, m.p. same), and the



(I) (II) (III)

anhydride prepared on treatment with acetyl chloride, m.p. 195° (Komppa, m.p. same).

Further work is in progress by way of extending this reaction with other conjugated double bonded systems.

P. C. GUHA.
D. K. SANKARAN.

Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
January 9, 1937.

[1] *Annalen*, 1909, **368**, 146.

A New Strain of Mid-Late Kolamba Rice.

IN the Bombay Presidency the coastal districts of Thana and Kolaba grow nearly 600,000 of acres annually, representing roughly 30 per cent. of the total acreage under rice in the Presidency. The most widely grown variety of rice is Kolamba. It is a late variety, fine grained, and produces a good table rice. Compared to other varieties it fetches better prices and is usually grown by cultivators as a money crop.

One of the major aims of the Agricultural Department has been to spread the Kolamba type of rice as wide as possible. This has been achieved by releasing improved early and late strains of Kolamba. The Department had still on hand the problem to evolve a type possessing fine grains combined with high yield and early maturity which would replace mid-late coarse grained varieties extensively grown in the two districts. Exploitation of the local Kolamba material was of no avail in this direction. Hybridization was the only alternative.

Although many crosses were made, only one of these, involving a late, fine grained and high yielding Kolamba strain, K 226, and a mid-late, coarse but long grained Kolamba, K 164, yielded desirable combinations. From this cross two promising fine grained cultures were obtained. Of these, one proved consistently high yielding and competed successfully with the bold-grained rices. The strain is designated K 540.

The field trials of K 540 in the Thana district proved a great success from the very beginning and the cultivators took up the strain without hesitation. During the last three seasons (1933–34–35) it has been compared at various places with mid-late large grained varieties such as Dodki, Dangar-wel and Patni and has given an average of 2385 lb. per acre, as against 2262 lb. of the local varieties. Its highest yield was 2688 lb. and lowest 1990 lb. per acre.

Kolamba 540.

K 540 is of medium height (140 cm.) with an average of little over 6 tillers per plant. The earheads are very compact (see photograph). The strain ripens in 130 to 135 days. The average length of the grain is 7·59 mm. and breadth 2·17 mm. Seventy-five to seventy-seven grains are required to weigh a gramme, as against thirty-five to fifty grains of the coarse varieties. The natural test weight of paddy of the new strain is 45 lb. per Imperial bushel. The fine quality of K 540 fetches a premium of Rs. 10 to 15 per candy of 1400 lb.

The strain is now spreading rapidly in the two districts of Thana and Kolaba. The

preliminary field trials in Gujrat, Ahmednagar and Ratnagiri districts indicate that K 540 may prove a valuable variety in those regions also.

B. S. KADAM.

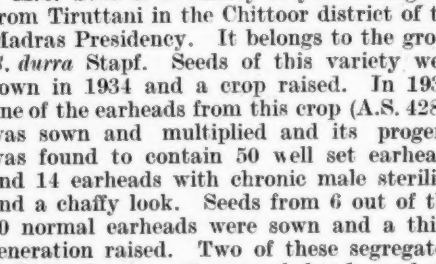
Rice Breeding Station,
Karjat (Kolaba),
October 19, 1936.

The Occurrence and Inheritance of Earheads with Empty Anther Sacs in Sorghum.

THE details of the anthesis and pollination in sorghum have been published.[1] The numerous anthers with abundant pollen grains, night flowering, antheriferous pedicelled spikelets and the general arrangement and sequence of flowering, all point to a perfection in the pollination arrangement in sorghum, the premier cereal of dry tracts. It is therefore interesting to record an instance in this millet in which the anther sacs are empty with the resultant sterility of the earheads.

M.S. 1761 is a variety of yellow sorghum from Tiruttani in the Chittoor district of the Madras Presidency. It belongs to the group *S. durra* Stapf. Seeds of this variety were sown in 1934 and a crop raised. In 1935, one of the earheads from this crop (A.S. 4282) was sown and multiplied and its progeny was found to contain 50 well set earheads and 14 earheads with chronic male sterility and a chaffy look. Seeds from 6 out of the 50 normal earheads were sown and a third generation raised. Two of these segregated again and gave 47 normal heads and 18 sterile heads.

The sterile heads were examined and it was noted that the sterility was due to empty anther sacs. The normal anthers are deep yellow when fresh and dehisce well. The empty anther sacs are very light yellow in colour and do not dehisce. Normal anthers are about 3·3 mm. long and 1·0 mm. broad. Empty anthers are small and about 2·0 mm. long and 0·5 mm. broad. (See illustration.)



Normal Empty
Sorghum anther sacs,

A number of anther sacs from sterile earheads were examined and found to be devoid of contents. The stigmas were however normal and quite receptive to foreign pollen, so much so that by contact with neighbours odd grains could be found set on them, the percentage of such crossing varying according to proximity to available foreign pollen. Three earheads with empty anther sacs were selfed and no grains set on them.

It is remarkable that a single gene could play such havoc on so well organised an earhead as that of sorghum. Empty anther sacs that have proved a simple recessive character, have been recorded in maize.[2] As far as the authors are aware, this is the first record of the occurrence and inheritance of empty anther sacs as a simple recessive mendelian character in sorghum. This male sterility gene has, as in maize, been designated *ms*. *Ms* is a simple dominant to *ms*.

G. N. RANGASWAMI AYYANGAR.
B. W. X. PONNAIYA.

Millets Breeding Station,
Coimbatore,
December 2, 1936.

---

[1] *Ind. Jour. Agric. Sci.*, 1931, **1**, 445-454.
[2] J. Herd, 1921, **12**, 138-141.

Roots from the Stalks of Sorghum Earheads.

IN the hot weather crop of 1936 in the third generation progenies of a cross between the sorghum varieties Kafir (*Sorghum caffrorum*, Beauv.) and Milo (*Sorghum caudatum*, Stapf var. *milo*) three plants were noticed with root-like protrusions on the freshly emerged earhead. These outgrowths grew perpendicular to the stem inside the head mass and then turned down. As the earheads grew, these projections (which proved to be roots from the stalk) also elongated. In one of the earheads the growing roots clasped the panicle branches below and impeded their free expansion. The growing roots were fresh in the period of rapid growth and in a fortnight wilted and dried up. In one of the three heads a single root arose from a joint on a panicle branch in the place of a branchlet. In the two other cases the root cluster started from a node in the central stalk. It originated in a bunch from one side of the stalk. At the rooting node there was a total suppression of the panicle whorl. In one case, there were five roots (Fig.) and in the other six roots

HP. 421.
Closer View of 420.

springing up. They varied in length from 2 to 13 cm. and in diameter from 2 to 3·5 mm. Two out of the five roots in one head and three out of the six roots in the other were branched. All the roots had root hairs when fresh. A section of the root showed that in structure it was like that of a normal root.

The lower nodes of the stalks of the sorghum plant are capable of producing stilt roots.[1] Given sufficient facilities the nodes higher up can also root. Axillary buds are potential shoots that develop when stimulated; so also are the roots potentially present in the root band at the node. One instance is on record in which roots arose from a wound in the leaf-sheath of sugarcane.[2] That profuse root formation both on the stem and the leaves of many species of plants can be produced under the stimulus of certain chemicals such as carbon monoxide gas and certain unsaturated hydrocarbon gases as ethylene, acetylene and propylene has been experimentally shown.[3,4] Mutilation and natural injuries have also been known to induce root development in certain plants.

To our knowledge there has been no record of an instance in Gramineæ of roots developing from the stalks of the earheads. This rare phenomenon seems therefore to be a faint echo of that ancient history of the plant which in ages past initiated the differentiation of structures into shoot and root. This somatic reversal might have been induced through the wide mating under radically different environmental conditions. The formation of bulbils,[5] the forking of leaves and awns,[6] the forking of midrib,[7] and now the production of root from the central stalk of the earhead seem as it were to be episodes in this ancient evolutionary history.

G. N. RANGASWAMI AYYANGAR.
A. KUNHIKORAN NAMBIAR.
Millets Breeding Station,
Coimbatore,
November 19, 1936.

1 *Curr. Sci.*, 1935, **3**, 485-86.
2 *Proc. 4th Cong. Int. Soc. Sugarcane Technology*, 1932, *Bull.* No. 73, 19.
3 Contributions from Boyce Thompson Institute, 1933, **5**, 1-17.
4 Contributions from Boyce Thompson Institute, 1933, **5**, 351-69.
5 *Curr. Sci.*, 1935, **3**, 362-63.
6 *Curr. Sci.*, 1935, **4**, 316-17.
7 *Madras Agric. Jour.*, 1930, **18**, (10), 526-30.

Internal Proliferation in *Carica papaya* Linn.

IN a recent issue of the *Current Science*[1] Sayeeduddin and Bari have published an interesting article under the above caption. Without offering any comment whatsoever, I may point out that a perusal through the literature on the subject shows that similar abnormalities in the fruits of *Carica papaya* were already recorded and described from Honolulu by Bergman in 1921 and later in 1925 also.[2] The authors are, therefore, referred to the above two important papers before actually taking up any detailed investigation in connection with the internal proliferation in the fruits of *Carica papaya*.

R. SHAH.
Agricultural Research Institute,
Sabour, Dist. Bhagalpur (Bihar),
January 10, 1937.

1 *Curr. Sci.*, 1936, **4**, No. 10, 740-41.
2 Bergman, H. F., *Bot. Gaz.*, 1921, **72**, No. 2, 97-101; *Bot. Gaz.*, 1925, **79**, No. 2, 222-23.

REVIEWS.

Cathode-Ray Oscillography. By J. T. MacGregor-Morris, M.I.E.E., and J. A. Henley, M.Sc. (Eng). (Chapman and Hall, Ltd., London), 1936. Pp. xiii + 249 with 151 illustrations. Price 17*sh.* 6*d.*

Prof. MacGregor-Morris and his associates are known for their interest and work in cathode-ray oscillography: it is appropriate that this book has been written by them. They give a brief history of the development of the cathode-ray oscillograph from the time of Thomson and Braun up to date and describe the physical principles underlying its theory and performance. In Chapters 4 and 5, they examine in some detail the constructional features and performance-characteristics of a number of makes of (*a*) the cold cathode type (Rogowski, Finch, General Electric, Knoll, etc.), (*b*) the hot cathode gas-filled type (von Ardenne, Cossor, Ediswan, Standard Telephones and Cables, etc.), and (*c*) the hot cathode high vacuum type (von Ardenne, Ediswan, General Electric, RCA, etc.). On page 94 is mentioned the ingenious Messner 200 kv. deflection chamber which does away with the potential divider. The multi-element Knoll oscillograph is very interesting. It is surprising to read about a 1000 volt cold cathode instrument (page 78).

Chapter 6 contains an inadequate and almost superficial discussion on the auxiliary apparatus such as power supply, pumps, etc. In another edition this can either be omitted or rewritten adequately. The authors refer to the suggestion of Finch to measure accelerating voltages by electron diffraction patterns. The discussion on time bases is useful and covers the ground fairly well. The beginner would have been helped by fuller data regarding complete circuits and their frequency ranges.

The cold cathode oscillograph finds its chief uses in investigations on lightning discharges and travelling waves, on power transmission lines and properties of insulating materials under impulsive voltages. The principal circuit arrangements for time sweeping, beam trapping and releasing, etc., are discussed in Chapter 9. The next one deals with a few important applications of the hot cathode instrument in different lines of work. The book closes with a brief outline of television transmission and reception.

Containing much useful information gathered together from many scattered sources, the book will gain greatly if the next edition is revised thoroughly to be free from the considerable number of easily avoidable errors particularly in the important Chapters 2 and 3 dealing with the dynamics and the optics of the electron. Here are some that were noticed in going through the book.

It is more appropriate to write "ionisation" for "excitation" (page 12, line 5). The velocity of the electron is not given by $\sqrt{\frac{2\ e\ V}{m_v\ 300}}$ but by the formula that follows it (page 17). On pages 20, 21, 27, etc., the symbols V, ϕ, E and ϵ are used to denote electric potential sometimes in volts and sometimes in electrostatic units. There is a similar confusion in regard to *e*, the charge on the electron. The radius of curvature of the path of an electron is ρ on page 22 and *r* on page 27. On page 27, $v \cos at$ should be $(v \cos a)t$. There appears to be no need for the word "infinite" on page 19, line 5. The reference to fig. 6(*c*) (page 32, line 6) should clearly be to 11(*c*) on page 29. The symbols in the first line on page 45 need correction. Considering the importance of Chapters 2 and 3, it will be useful to derive equations (11) and work out in more detail the lens equations, both magnetic and electrostatic.

Fig. 20 referred to on page 91 should surely be fig. 48. Again three-quarters down page 170, fig. 1 should be fig. 99.

The printing is good and the illustrations excellent.

R. E.

Television Reception, Construction and Operation of a cathode-ray tube receiver for the reception of ultra short wave television broadcasting. By Manfred von Ardenne. Translated by O. S. Puckle, A.M.I.E.E. (Chapman and Hall, Ltd., London), 1936. Pp. xv + 121 with 96 illustrations. Price 10*sh.* 6*d.* net.

The author is well known in Germany and outside for his valuable contributions to radio

technique, particularly in developing the cathode-ray oscillogrph tube and television reception. The translation from German into English has been ably carried out by Mr. O. S. Puckle, himself a recognised British investigator in the field. A very useful feature to the television enthusiast in Great Britain is the inclusion of details of British television transmissions and of television apparatus of British make. Discussion is confined to technique and apparatus developed by the author and by the translator.

The book begins with a succinct statement of the essential technical aspects of television transmission such as wave-length, field-strength, wave-form, etc., and of reception requirements involving inevitably the use of the high vacuum cathode-ray tube with its associated circuits for time bases and synchronisation. The second chapter contains much interesting and useful information on the theory, details of construction and performance of the high vacuum cathode-ray tube. This is followed by a discussion of the power supply to the oscillograph tube, time bases and their synchronisation with the transmission. The all vacuum tube time base circuit originated by Mr. Puckle and his co-workers is also described. The circuit diagrams and data regarding components give all the necessary details to enable the constructor to build up his own apparatus. The effects of different line and picture frequencies are intriguing (pages 75–78).

The chapter on amplitude filter to separate the synchronisation pulses emphasises the need for further experimental work.

While the difficulties of the very low wave-lengths are common both to sound and picture receiving equipment, the design and operation of the latter is governed by the need for uniform amplification over a frequency band width, not of 10 to 15 kilohertz, but of at least 1 megahertz. And the stage gain has to be of the order of 10 to 15 times to prevent self-oscillation and to keep down the cost. These considerations are dealt with in Chapters VII and VIII.

The results of television reception with the equipment described in the book are summarised in the last chapter.

This modest volume is packed with very useful and worthwhile information presented with admirable clarity and economy of words. There is much that is new, and the detailed requirements of the technically minded amateur constructor are anticipated at every turn. The descriptions of intricate apparatus and of physical principles are always lucid and accurate though without the aid of mathematical treatment. The illustrations are excellent and very well chosen.

When a revised edition incorporating progress subsequent to 1935 will be brought out, the following will perhaps receive attention. In Fig. 39A, the resistances are better shown differently from the transformer windings, say as in Fig. 39B. In Fig. 48, page 60, R_1 is not marked. On page 64, the term vigorously pointed out can be replaced by emphasised. On page 93, line 18, transmission would perhaps be more suitable than transmitter.

R. E.

Electronics and Electron Tubes. By E. D. McArthur. (John Wiley and Sons, New York ; Chapman and Hall, London), 1936. Pp. viii + 173 with 89 figures. Price 12*sh*. 6*d*. net.

The study of electronics and of the applications of electronic devices in daily life continue to fascinate a growing number of people. The present work is by an active worker in the field in one of the national homes of electronics, the research laboratories of the General Electric Company of the U.S.A.

The book begins naturally with a brief mention of the nature and properties of electrons, atoms and molecules and radiant energy ; the elements of the kinetic theory of gases and the phenomena of excitation and ionisation occupy the next chapter. The third is mainly concerned with thermionic emitters and emission and the associated phenomena ; photo-emission is touched upon. Space current characteristics of single and multi-grid vacuum tubes for continuous and varying voltages are taken up next. The latter topic is inadequately treated, considering its importance. There are a few pages on A, B and C class amplifiers. Amongst the uses of vacuum tubes mentioned by the author, that for producing artificial fever for the treatment of certain diseases is of interest.

Cathode-ray tubes, tubes for generating micro waves and high voltage high vacuum rectifier tubes are briefly discussed. The last chapter on the construction of electron tubes could well have been much more comprehensive, in view of lack of any literature on the subject.

The feature of the book is the survey of the physical action inside gas or vapour filled electronic tubes and their practical

applications for control and conversion of power.

The simple and direct language and the absence of any mathematics (except for a few formulæ) should enable even a comparatively non-technical reader to follow the clear, and authoritative discussion of the basic ideas and principles underlying the main electronic phenomena and devices.

The printing and get-up of the book are excellent. R. E.

The Thermochemistry of Chemical Substances. By F. Russell Bichowsky and Frederick D. Rossini. (New York: Reinhold Publishing Corporation; London: Chapman and Hall), 1936. Pp. 460. Price 35*sh*.

The present book supplies an assembly of the tables of values for the heats of formation of chemical substances. It is well known that Dr. Bichowsky collated all published data for the International Critical Tables. The present book is a complete revision and extension of that work. The table of data covering 150 pages deals with different elements in their atomic states as well as molecular formation. In the case of diatomic molecules the band spectra data for the lowest level as well as for other energy states have been supplied. For the majority of the polyatomic molecules forming different compounds the data being those derived from thermochemical investigations. In the case of the atoms the energy-states are derived from the tables of Bacher and Goodsmith and Russel Saunder's notation has been uniformly followed. Besides the tables there are 200 pages of texts furnishing explanations in support of the different values collected in the tables, giving full references for each of the investigations from which the data have been derived. There is further an alphabetical index of references of the different authors. This book thus is a great interest for workers in atomic and molecular physics. It had been difficult to secure the necessary data required in the investigations as the materials had been growing at such a rapid rate within recent times.

Recent Advances in General Chemistry. By Dr. Samuel Glasstone. (J. and A. Churchill Ltd., London), 1936. Pp. vii +430. Price 15*s*.

This book is a companion to the writer's *Recent Advances in Physical Chemistry* and is intended to bring before chemists the important developments in the "borderland between physical chemistry, on the one hand, and inorganic or organic chemistry on the other".

The book is divided into nine chapters which present, respectively, developments in the following topics: atomic disintegration, statistical methods, ortho- and para-hydrogen, deuterium and its compounds, electron diffraction by gases and vapours, solubility, the mechanism of reactions in solution, acid-base and salt catalysis, and simple organic free radicals.

The mode of treatment employed is particularly helpful to the graduate or post-graduate student. For instance, the chapter on Atomic Disintegration commences with an account of Rutherford's work relating to emission of protons as a result of disintegration by α-particles. The mechanism of disintegration, applicability of the laws of conservation of mass and energy, and the principle of energy levels are then presented in outline. This is followed by an account of the discovery of the neutron, its production, important properties and its employment in disintegration experiments. Then follows a similar account with regard to the positron. The neutrino and the negative proton are very briefly touched upon. An account is then given of the work relating to disintegration by protons and deuterons and the results obtained are briefly discussed. This is followed by a comprehensive account regarding work on artificial radioactivity and the methods employed in chemical identification of unstable isotopes. The use of neutrons as projectiles and the types of disintegration produced by them are next mentioned in outline. Short discussions on nuclear stability, the trans-uranium elements and the applications of artificial radioactivity form the concluding topics of this chapter.

Every chapter is written with due regard to the relative importance of the topics discussed and includes a fairly comprehensive list of references to original work. The book is written in language which is at once clear and concise. The printing and get-up is excellent. It can be heartily recommended for careful study by graduate and post-graduate students of chemistry and by professional chemists as well.

K. R. K.

Recent Advances in Physical Chemistry. By Samuel Glasstone, D.Sc. (J. and A. Churchill Ltd., London), 1936. Third Edition. Pp. 477. Price 15s.

The book includes the following chapters:—the Electronic Theory of Valency, the Parachor, Dipole Moments, Molecular Spectra, Homogeneous Gas Reactions, Photochemical Reactions, the Properties of Surfaces, Heterogeneous Catalysis, and Strong Electrolytes. The subjects have been treated in an essentially non-mathematical form, so that students with ordinary mathematical equipment may grasp the significance of the advance in our knowledge of these subjects made in recent years. The references at the end of each chapter have been carefully selected, and will be helpful to those who intend to study the problems at first hand. A bold attempt has been made to give an elementary exposition of the principles of quantum mechanics in their application to problems of valency and molecular structure, but the reviewer has misgivings if such attempts can ever be made really successful.

The book on the whole has however been very well written and deserves the popularity which it has already won among senior students of Chemistry in Universities.

J. C. G.

Tungsten; a Treatise on its Metallurgy, Properties and Applications. By C. J. Smithells, D.Sc. (Chapman and Hall, London), 1936. Pp. 272. Price 25s. net.

The first edition of this book was published in 1926, some twenty years after the granting of the first patent for the manufacture of tungsten filaments. An enormous amount of work was carried out on tungsten during these twenty years; in spite of that the last ten years has brought a great increase in our knowledge of the properties of the metal and of its industrial applications; the second edition of this book is nearly twice the length of the first.

The development of wireless transmission has stimulated work on thermionic emission, much of which has been done with tungsten filaments, though they have now been replaced to some extent by more efficient sources. The most important of the new industrial applications of the metal lies probably in the development of the hard tungsten carbide cutting tools. In milling operations with these tools, the cutter speeds are three to four times higher and the table speeds two to three times faster than those used with high-speed steel cutters. The carbide has also been applied with outstanding success in the field of dies; for example in the drawing of steel wire 264 chilled iron dies were employed in a 12-day period; during the same period a tungsten carbide die drew 20 per cent. more wire and suffered no die enlargement. Sand blast nozzles fitted with carbide inserts have a life six hundred that of nozzles made from manganese steel. Important developments have also taken place in the production of non-ferrous tungsten alloys in which tungsten is a major constituent, and improvements have been effected in both the mechanical and magnetic properties of tungsten steels.

The field of application has become so large that the author has obtained the co-operation of experts in the preparation of certain chapters of the book. The information given covers a wide field and the book can be regarded as a real contribution to metallurgical literature.

T. S. W.

Annual Review of Biochemistr[illegible] Vol. V, 1936. Edited by James [illegible] Luck. (Stanford University P.O., California, U.S.A.). Pp. ix + 640, Price $ 5·00.

The colossal task of bringing together in one volume the reviews of the progress of Biochemistry in the year 1935, has been accomplished in this annual publication, to whose periodic appearance research workers, the world over, eagerly look forward. This ably edited review comprises 26 sections each of which has been reviewed by authorities on a truly international basis, thus ensuring a publication not limited by regional considerations. This circumstance alone is compelling enough to bestow on this publication a place of respect and authority.

An idea of the comprehensiveness of this publication can be obtained, when it is mentioned that citations to about 3,800 papers from about 3,500 different workers are comprehended in it. It comprises 26 sections, and reviews on soil microbiology, application of X-ray methods to the elucidation of the structure of compounds of biochemical interest and clinical application of biochemistry, subjects not treated in the earlier volume, have been included in it. The phenomenal output of research on vitamins has made it necessary to

review the work under the heads, the fat-soluble and water-soluble vitamins. Among other departures, mention may be made of the addition of a separate section on the chemistry and metabolism of the compounds of phosphorus. The section on animal pigments will serve as a complement to the section on plant pigments which appeared in the previous volume. There are also other additions which will be welcomed. The section on permeability, alkaloids, chemical embryology and immunochemistry which found a place in the earlier review, do not find a place in the present volume.

The review will undoubtedly stimulate and inspire further enquiry into the various problems dealt with. The contributors and the Editors have placed the readers under a deep debt of gratitude for placing in their hands a volume which they will find not merely valuable but indispensable.

Experimental Enzyme Chemistry. By Henry Tauber. (Burgess Publishing Company, Minneapolis, Minn., U.S.A.), 1936. Pp. v+118.

This recent mimeographed publication by an active worker in the field of Enzyme Chemistry, will be warmly welcomed by biochemists, as it provides in a handy volume, useful notes on the more common enzymes. No attempt at completeness is made and the book is not intended to provide a comprehensive review of all the recent researches on enzymes or to duplicate material already provided in the books readily available. The author has set himself the task of merely presenting in a classified form, an account of the more recent advances and he has in a large measure succeeded in doing this.

The book contains 11 chapters. The first furnishes some useful notes on the general aspects of enzyme actions. Subsequent chapters deal with the preparation and reactions of individual enzymes. Considerable space is devoted to the discussion on the chemical nature of enzymes and it is pointed out that many enzymes are proteins. This should be expected from a worker belonging to the American School of Enzyme Chemists, who have succeeded in crystallising a number of enzymes, all of which happen to be proteins. It should, however, be recognised that this circumstance does not nullify the *carrier* theory, promulgated by Willstatter. Valid arguments have been provided to show that enzymes are not mere proteins. The value of a theory has to be judged by the extent to which it can provide convincing explanation for experimental observations, and judged from their standard the *carrier* theory has been extremely successful. It is surprising that while discussing the *carrier* theory which postulates that proteins are only exchangeable carriers of the active groups, replaceable by other colloids of high molecular weight, the author should have said "the active principle has never been isolated, and *there is little hope that it ever will be*" (page 13, *italics, ours*). It is not less surprising to find that the author considers that the attempts to separate proteins from the active portions of the enzymes, "retarded the advancement of our knowledge of the chemical nature of enzymes". Few will agree with this view of the author.

Any discussion on the merits of the rival theories should be considered out of place in a review. The reviewer is, however, tempted to point out that such arguments as those advanced by the author on page 13 "glutathione acts in every respect like an enzyme. ....Then according to the carrier theory, the tripeptide would be only the carrier of the active principle", do not carry conviction.

The bibliography is the most valuable feature of the book. It is comprehensive and most of the references are to recent literature. Several citations are also given for reviews of recent researches on different enzymes. The book will be particularly valued for this feature. There are a few obvious errors, such for instance as that on page 112, where it is said that carboxylase acts on methyl glyoxal and acetaldehyde; no mention has been made of glyoxalase. These and others will, we are confident, be eliminated in the next edition. We should also like to see more experimental details in a book entitled *Experimental Enzyme Chemistry*, so that the book may be useful in the laboratory. The present mimeographed edition should be viewed as a definite stage in its evolution into a more thorough and comprehensive laboratory manual.

CENTENARIES

S. R. Ranganathan, M.A., L.T., F.L.A.,
University Librarian, Madras.

Guyton, De Morneau (1737-1816)

DE MORNEAU GUYTON, a distinguished French chemist, famous as the father of the modern chemical nomenclature, was born on January 4, 1737, at Dijon. His father was a professor of law and in spite of his early manifestation of a remarkable aptitude for practical mechanics, he was admitted in the Law School of the University of Dijon in his sixteenth year. He practised law at Paris from 1757 till 1761, when he was appointed Advocate-General in the Parliament of Dijon, although he was only 24. He held this post till 1782. He took part in politics and in military life till 1797, when he became the Director of the Polytechnic School, of which he was one of the founders. During the period 1800 to 1814, he held the appointment of the Master of Mint.

A Good in Disguise

The story of Guyton turning to chemistry savours of the Viswamitra-Vasishta episode. What turned his attention to the study of chemistry was a slighting remark which Prof. Chardenon of Dijon made in reply to an observation of Guyton at the close of a lecture on chemistry. Smarting under this insult, with "practice for his master and melted crucibles and retorts for tutors", Guyton set himself for a thorough, though private, study of chemistry until he obtained such a mastery over his subject as to draw from Prof. Chardenon himself the public acknowledgment that he was "born to be an honour to chemistry".

His Contributions to Chemistry

In his *Digressions academiques,* published in 1772, he set forth his views regarding phlogistan and crystallisation. One of his first successes was his process of disinfecting vitiated air by fuming with hydrochloric acid gas. This, he discovered in 1773. In 1774, he succeeded in establishing a course of extension lectures at Dijon for the dissemination of scientific knowledge and he himself conducted the lectures in chemistry continuously for thirteen years. He next turned his attention to industrial chemistry. In 1778, he founded a saltpetre manufacture on scientific principles and in 1783 he established the first soda-works of France. In 1794 he accompanied the French army into Belgium where he constructed a balloon and made a balloon ascent for military purposes.

Chemical Nomenclature

His chief fame justly rests on the pioneering work he did in establishing a scientific nomenclature in chemistry, which has stood the test of time till to-day. The chemical nomenclature at that time in use had originated with the medical chemists, and contained a multiplicity of unwieldy and unmeaning, and even absurd, terms. It had answered the purposes of chemists tolerably well while the science was in its infancy; but the number of new substances brought into view had of late years become so great, that the old names could not be applied to them without the utmost straining: and the chemical terms in use were so little systematic that it required a considerable stretch of memory to retain them. These evils were generally acknowledged and lamented, and various attempts had been made to correct them. Guyton's first unsuccessful attempt at nomenclature appeared in the issue for May 1782 of the *Journal de physique.* Being based on the phlogistan theory, which was then being exploded, it was violently criticised by Lavoisier, Berthollet and other chemists of Paris. Thereupon, he went to Paris to confer with them. After readjusting his views to the progressive school of chemistry at Paris, in conjunction with his once opponents he brought out in 1787, the *Methode d'une nomenclature chimique,* the principles of which were speedily adopted throughout Europe. This book and the *Elemens de chymie theorique et practique* (3 V. 1778) made him so famous that he was invited to contribute the chemical part of the *Encyclopedie methodique* (1786–92).

His Personality and His Honours

In the earlier years, his aggressive attempts to extract due recognition for scientific pursuits induced an antagonistic attitude in the mind of the public who were as yet far from conceding to the prerogatives of science. They accused him of "presumptuously disarming the hand of the Supreme Being". Once when their exasperation led them to destroy the lightning conductors which Guyton had put up at the Academy Buildings, the conductors could be saved from

vandalism only by a tactful assertion by the Secretary of the Academy that "the astonishing virtue of the apparatus resided in the gilded point, which had purposely been sent from Rome by the Holy Father." In spite of such early experiences, his life was crowned with honour and public recognition toward the end of his career. In 1796, he was made a member of the Institute. In 1803, he received the Cross of the Legion of Honour. In 1805, he was made an Officer of the same Order and in 1811, Napolean made him a Baron of the French Empire.

He died at Paris on January 2, 1816, full of age and full of honours.

Franchini, Pietro (1768-1837)

PIETRO FRANCHINI, the Italian priest and mathematician, was born on April 24, 1768, at Partigliano, near Lucca, in Italy. Though ordained a priest, he was for some time professor of philosophy at Rome and for a long time professor of higher mathematics in various places but mostly at Lucca. He is reputed to have been a mathematician of considerable power, having written several works on the various branches of the subject and a number of papers of some originality on analysis.

His Books

His first book entitled *Teorie dell' analisi* (3 V.) was published in Rome in 1792 and a supplementary volume appeared two years later. His *Trattato d' arithmetica* and *Memoria trigonometria* came out at Lucca in 1804 and 1808 respectively. Another considerable work in four volumes was published at Livorno in 1816 and 1817 under the title *La scienza del calcolo.* 1819 saw yet another book of his under the title *Elementi di algebra.*

His Papers

He published as many as sixteen learned papers in several Italian periodicals but chiefly in the *Atti della academ. Lucchese.* His first paper dated 1797 was *Sur la resolution des equations d' un degre quel conque,* while his last came out in 1835 under the title *Di alcuni problemi celebri.*

History of Mathematics

He also wrote three works on the history of mathematics, *viz.*, (1) *Seggio sulla storia mathematische* (1827); (2) *La storia della algebre et de' suoi principali scrittori* (1827); and (3) *Dissertazione sulla storia mathematica della antica nazione Indiana* (1830). The last-mentioned book, which was published in Lucca, should be of special interest to the readers of *Current Science.*

Franchini died at Lucca on January 26, 1837.

Macnish, Robert (1802-1837)

ROBERT MACNISH, the short-lived Scottish physician, was born in Glasgow on February 15, 1802. Medicine being the hereditary profession of his family, he obtained the M.C. degree of the University of Glasgow at the early age of eighteen. After a short practice at Caithness, he studied medicine at Paris for a year and eventually got his degree of M.D. at Glasgow in 1825. His research thesis, entitled *The anatomy of drunkenness,* was justly famous for its freshness and thoroughness. It was published in 1827. It enjoyed wide popularity for a long time, the third edition coming out in 1859.

Philosophy of Sleep

For some years he diverted his pen to the production of a variety of literary pieces, of which the fantastic fiction *Metempsychosis* marks the high watermark. After a prolonged illness which kept him from any serious work in 1829 and 1830, he published towards the end of the latter year his best known and most important work *The philosophy of sleep.* It was reputed to have been "a clear, lively, and well arranged account of the phenomena". About this time, he was greatly occupied with the epidemic of cholera and was one of the first to assert the contagious character of the disease.

Borderland of Psychology and Medicine

During the few years of his life that still remained, his interests definitely swerved to the borderland of psychology and medicine. His *Introduction to phrenology in the form of question and answer* came out in 1835. This book obtained great popularity, as many as ten thousand copies having been sold in a short time. In 1836 he edited Dr. Brigham's *On the influence of mental cultivation and mental excitement on health.*

His Personality

As a medical writer he displayed the graphic power of a delineator and as a man, he was one " who could not be known without being beloved ". While engaged on the revision of his *Introduction to phrenology* for a second edition, the epidemic of influenza counted him as one of its tolls on January 16, 1837.

Lightning Studies.

By Anna McNeil (*Scotia, N. Y.*).

SCIENTISTS turn their attention to the entire realm of Nature with the hope of harnessing mighty forces and making them subservient to man's use. Lightning in itself may not be tamed, but its cause is known, its action studied, its effects may be averted insofar as they disturb electrical transmission lines, and man has made artificial lightning in the great laboratories of industry and has caused it to strike and shatter objects that have been designated for the purpose.

It is estimated that an average of forty-four thousand thunderstorms takes place daily, the world over, and that the power of the lightning dissipated in these storms is equal to 1,200,000 kilowatts, or the glow of thirty million electric lamps of medium size.

Lightning over Milwankee, Wisconsin, U.S.A.

One of the great lightning investigators was a Hungarian named Lenard. The descending drops and rising spray of a waterfall gave him a clue to the nature of lightning. He found that small drops of water are blown upward just as thunderheads are piled high by the wind. The small drops in the spray carry negative charges of electricity and large drops carry positive charges. He reasoned from this that the small drops of water that rise upward in a thunderhead are negatively charged while the larger drops that remain in the lower part of the cloud carry positive charges. The earth is charged negatively.

When the difference between the charge of the upper and lower parts of the cloud; between the lower part of the cloud and the earth; or between parts of one cloud and another, become too great, there is a flash of lightning with the accompanying rumble or crash of thunder. On transmission lines the flash may cause a sudden rise to as high as four or five million volts.

Lightning may pass from the earth to a cloud as well as from a cloud to the earth. When a tree is struck by lightning a current of great intensity is gathered up from the earth. It passes up the tree through the air and charges

Lightning Observatory, top of building 42, General Electric Co., Pittsfield Works. 102 ft. above ground, equipped with periscope, dark room, camera platform, and other devices. First building of its kind erected solely for observation of natural Lightning.

the cloud to the same potential as the earth. This explains why it is extremely dangerous to stand under a tree for shelter during a thunderstorm and why so many cattle are killed through being struck by lightning.

Until recently it was believed that lightning never strikes twice in the same place—in fact, there is a time honored proverb to that effect. But lightning not only strikes twice, but as many as ten times. This has been proved by a special type of camera in which the film is whirled past the lens at a faster speed than a mile a minute. There is a time scale along the length of the film so that readings in millionths of a second are possible. The ten re-current discharges from cloud to earth; earth to cloud; and so on,

alternately, occur in a fraction of a second, and at this inconceivable speed could not be detected by the human eye nor by an ordinary camera.

Farmers have observed that their crops grow better after an electrical storm and have attributed the fact to the rainfall which is apt to be heavy at such a time. Lightning is really the responsible factor. Scientists in the great fertilizer plants are lately uncovering one of Nature's age-long chemical secrets. Lightning produces one-hundred-million tons of nitrogen over the earth's surface every year, depositing it upon the soil to aid all growing things. A bolt of lightning coming down through the air which is composed of approximately four-fifths nitrogen and one-fifth oxygen, breaks down the chemical constituency of the air and bestows fixed nitrogen upon the land as a boon to the farmer, at no cost. Lightning thus serves a useful purpose and is a blessing in disguise, however terrifying its form.

For years the General Electric Company has experimented with artificial lightning and has produced ten million volts in the laboratory. Recently an outdoor lightning observatory believed to be the only one of its kind in the world, has been constructed 102 feet above ground, on the roof of the largest building of the Pittsfield, Massachusetts, General Electric plant.

The strange-looking structure is equipped with a periscope and a twelve-lens lightning recorder camera. Built largely of metal, it is grounded to the steel framework of the building on which it rests. It is coated with aluminum paint on the outside; with flat black on the inside. It is fourteen feet in diameter, topped by an eight-inch crystal sphere.

Lightning flashing in any direction within a radius of twenty miles is reflected on the silvery surface of the roof and thence in the crystal sphere and is made visible through the eyepiece of the periscope by a mirror set at an angle of 45 degrees, in its dark-walled tube.

The camera is directly beneath the periscope platform. It is exposed to the weather when in use but is protected with a curtain of compressed air. The compressed air is admitted into a perforated metal ring beneath which the camera is placed. The invisible curtain does not interfere with the taking of pictures and effectually keeps out all but the most severe downpour.

RESEARCH ITEMS.

Linear Diophantine Approximations.—Khintchine (*Math. Ann. B.*, **113**, 398–415) has contributed an interesting article about the solution of the non-homogeneous n-dimensional $[n > 1]$ diophantine approximation problem. The theorem of Kronecker, *viz.*, that given n irrational numbers $\theta_1, \theta_2, \ldots\ldots \theta_n$, then corresponding to every $t > 1$ we can find integers $x, y_1, \ldots\ldots y_n$ such that

$$(1) \quad |x\theta_i - y_i| < \frac{1}{t}, \quad i = 1, 2, \cdots n$$

and $0 < |x| \leqslant t^n$. Khintchine considers the non-homogeneous case, *i.e.*, when (1) is replaced by (2) $|x\theta_i - a_i - y_i| < \frac{1}{t}$, where a_i's are given real numbers. It is well known even in case $n = 1$, this problem is not solvable if the restriction on x is the same as above (or even when t^n is replaced by Ct^n). It was recognised by the author long ago that the theorem would only be true with some restriction on the irrational number θ. Ten years ago he found out the condition in case $n = 1$. The condition expressed in terms of continued-fractions is that the quotients of the continued-fraction-development of θ were bounded. It should be observed that if the contrary is true then the homogeneous problem for θ is solvable with much less restriction on x. [*i.e.*, $x = o(t)$ instead of $x = O(t)$.] The theorem he proves is the generalisation of this to higher dimensions. It should also be noted that generalisations of diophantine approximations to higher dimensions is often impossible or extremely complicated. As the author observes that the inequalities $|x\theta - y - a| < \frac{1 + \epsilon}{\sqrt{5}\, x}$ is solvable for a sequence of values of x, and the analogue of this in the case of higher dimensions not being true. The extremely interesting result that he proves is the following:

Let $\theta_1, \theta_2, \ldots\ldots \theta_n$ be real numbers. The necessary and sufficient condition in order that a positive constant A exists satisfying the condition

$$o < x < At^n \; |x\theta_i - y_i - a_i| < \frac{1}{t}. \quad i = 1, 2, \cdots n$$

for all $t \geqslant 1$, is that there should exist another constant a (both the constants depend on the θ's such that the inequalities

$o < x < At^n \quad |x\theta_i - y_i| < \frac{1}{t}$ *does not* possess a solution for any integral t.

The necessity of this follows easily by a method analogous to the one-dimensional case. The proof of sufficiency is extremely intricate.

K. V. I.

A Very Accurate Test of Coulomb's Law of Force between Charges.—Taking Coulomb's law of the force between two charges to be given by $F = \frac{\sigma\sigma'}{r^{2 \pm q}}$, Maxwell showed that $q < 1/21600$. This result quoted in all text-books gives the limit of accuracy of the inverse square law as determined by Maxwell and we have had to be satisfied with it till to-day. Now S. J. Plimpton and W. E. Lawton (*Phys. Rev.*, 1936, **50**, 1066) report experiments which prove that the exponent of r in the law of force differs from 2 by less than 1 part in 10^9. The electrostatic method of Maxwell and Cavendish was replaced by a quasi-static method in order to eliminate stray effects due to spontaneous ionization and contact potentials. The principle however is the same: A spherical air condenser consisting of two concentric insulated globes is employed. The upper globe has a small hole closed by a lid which has a projection making contact between the two globes. The outer globe is first charged to a high potential,

V, the lid is then removed by means of a silk thread and the outer shell being now earthed, the inner globe is tested for charge. If the inner shell has a potential less than v, $q < \frac{v}{V} F(a,b)$ where $F(a, b)$ is a quantity depending on the radii a, b of the spheres. In the present experiment the authors employed a galvanometer having a frequency of two cycles per second as the detector and placed it inside the inner globe so as to do away with contacts. The frequency was chosen low so as to eliminate induction effects. The outer sphere was charged to more than 3000 volts by means of a sinusoidal E.M.F. of 2 cycles per second produced by a "condenser generator". Since the galvanometer was thus used as a resonance instrument, the electromagnetic induction effects were not of any consequence and on account of the low frequency the fluctuations due to them were below the variations due to Brownian motion. The galvanometer was operated by a five stage resistance-capacity coupled amplifier designed for a frequency of about 2 c.p.s. and was observed through a conducting window in the outer sphere. In this way it was found that $v = 10^{-6}$ volt could be easily measured but there was no such potential shown by the galvanometer when the outer shell was charged. Hence the authors conclude that since $F(a, b)$ was 0·169 and $V > 3000$ volts and $v = 10^{-6}$ volt, $q < 2 \times 10^{-9}$.

A Mass-Spectrographic Study of the Isotopes of Argon, Potassium, Rubidium, Zinc, and Cadmium.—The isotopic analysis of K and Rb is important on account of its bearing on the problem of the radioactivity of these elements. Regarding A, Zn and Cd there is some discrepancy between different workers; particularly in Zn and Cd Stenvinkel and Svensson have reported the existence of some isotopes, *viz.*, Zn^{63} and Zn^{65} and Cd^{118} from a study of the band spectra of ZnH and CdH, while Aston does not obtain these isotopes. Now Alfred O. Nier has given the results of an investigation employing a mass-spectrograph of high resolving power (*Phys. Rev.*, 1936, **50**, 1041). His findings are:

A. A^{40}, A^{36} and A^{38} are present. $A^{40}/A^{36} = 325 \pm 4$ and $A^{36}/A^{38} = 5{\cdot}10 \pm 0{\cdot}07$.

K. K^{39}, K^{41} and K^{40} exist. $K^{39}/K^{41} = 13{\cdot}96 \pm 0{\cdot}1$ and $K^{40}/K^{39} = \frac{1}{8600} \pm 10\%$.

Rb. Rb^{85} and Rb^{87} were found. $Rb^{85}/Rb^{87} = 2{\cdot}68 \pm 0{\cdot}02$.

Zn.

Mass Number:	64	66	67	68	70
Percentage:	50·9	27·3	3·9	17·4	0·5

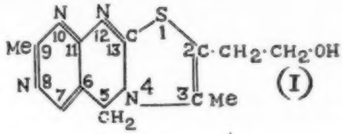
Zn^{65} and Zn^{63} were not found.

Cd.

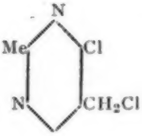
Mass Number:	116	115	114	113	112	111	110	108	106
Percentage:	7·3	0	28·0	12·3	24·2	13·0	12·8	1·0	1·4

Cd^{115} found by Aston is not confirmed and Cd^{118} was not observed. Making use of the isotopic constitution of K found by him the author concludes that K^{40} is the isotope responsible for the radioactivity of potassium, changing into Ca^{40}. In the case of Rubidium he considers that Rb^{87} is the active isotope changing into Sr^{87}, although the possibility of Rb^{85} being the active isotope is not entirely ruled out.

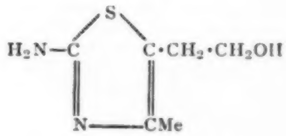
A Synthesis of Thiochrome.—Todd, Bergel, Frankel-Conrat, and Jacob have recently described (*J. C. S.*, 1936, 1601) a synthesis of thiochrome (I), a yellow basic substance which is present in yeast, and which can be obtained from aneurin (Vitamin B_1) by oxidation with potassium ferricyanide in alkaline solution. (*Cf.* Peters, *Current Science*, 1936, **5**, 209.) Condensation of acetamidine with ethyl formylsuccinate gave *ethyl 4-hydroxy-2-methylpyrimidine-5-acetate*, from which by Curtius degradation 4-hydroxy-5-aminomethyl-2-methylpyrimidine was obtained; this yielded *4-hydroxy-5-hydroxymethyl-2-methylpyrimidine* with nitrous acid; the corresponding *chloro*-compound (II) was then obtained with phosphoryl chloride. 2-Amino-4-methyl-5-β-hydroxyethylthiazole (IIIa or IIIb) was synthesised from methyl α-chloro-γ-hydroxypropyl ketone and thiourea. Thiochrome was isolated from the resin obtained on heating a mixture of (II) and (III) at 110° for a short time.



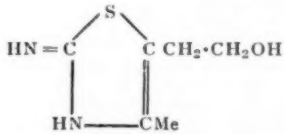
(I)



(II)



(IIIa)



(IIIb)

T. S. W.

Spermatogenesis of *Betta splendens*.—Fishes do not form such advantageous objects for germ-cell study as Amphibians do but *Betta splendens*, which has very few chromosomes for a Teleost and whose germ-cell elements are fairly large, offers good material. N. L. Bennington (*J. Morph.*, 1936, **60**, No. 1, December, p. 103) has studied the germ-cell origin and spermatogenesis in this animal. The following are his main observations: Residual spermatogonia larger than the normal spermatogonia persist along the walls of the lobules of the testis and give rise periodically to primary spermatogonia. The diploid chromosome number is 42, two of which are supposed to be sex chromosomes. During the division of the primary spermatocyte, the sex chromosome lags behind on the spindle. It is concluded that *Betta* is a form where the sex chromosomes are not very greatly differentiated from the autosomes. But no genetic evidence for the sex chromosomes is offered in the animal.

Growth and Division in Specialised Tissues.—Interesting data are afforded by A. Cohen and N. J. Berrill (*J. Morph.*, December 1936, **60**, No. 1, 243) on the methods of growth and division in specialised tissues in vertebrates. In the notochord for instance, it is only the non-vacuolated cells at the posterior tip and the periphery that divide. Vacuolated cells never divide. In the retina it is only the non-specialised cells occurring at the periphery that undergo division. The specialisation which progresses from the periphery to the centre marks the end of all cell division. The cells of the gut epithelium also divide by mitosis but during division a round shape is assumed by the cells and all functional activity stops. Fully formed cartilage cells divide both by mitosis as well as amitosis. It is concluded that the ability of functional cartilage cells and cells of the gut epithelium to divide is due to their comparatively simple structural differentiation as opposed to notochordal and retinal cells where specialisation has been carried so far that division is impossible.

SCIENCE NOTES.

Royal Asiatic Society of Bengal.—At the ordinary monthly meeting, held on the 4th January, an important contribution on *the Alimentary Canal of* Epilachna Indica (*Coccinellidæ : Coleoptera*), *with a discussion on the Activities of the Mid-gut Epithelium*, was read by S. Pradhan.—'On a comparative study of the alimentary canals of carnivorous and herbivorous beetles of the family Coccinellidæ (Coleoptera), it was seen that there were a large number of both structural and physiological peculiarities in the case of *Epilachna Indica* which are important from the view-point of digestion among insects in general. The alimentary canal of another species of *Epilachna*, *i.e.*, *E. Corrupta*, has already been described by two American workers, Potts (1927) and Burgess (1932), but their accounts have differed from each other. In this paper the author has presented the results of his investigations on *E. Indica*."

At the same meeting Messrs. Narendra Chandra Vedantatirtha (*Calcutta*) and Maulvi Shamsuddin Ahmad (*Calcutta*), were balloted for as ordinary members.

* * *

The Second Annual Meeting of the Indian Academy of Sciences, was held on the 11th, 12th and 13th January 1937, Rajasabhabhushana Sir C. V. Raman, KT., F.R.S., N.L., presiding. The Inaugural ceremony was held at Sir Puttannachetty Town Hall on the 11th, when Mr. S. G. Forbes delivered an address. Two public lectures were arranged during the session one on the 11th by Sir C. V. Raman on 'Recent Advances in Astronomy and Astrophysics' (illustrated by lantern slides) and the other on the 12th by Prof. K. S. Krishnan on 'The Approach to the Absolute Zero of Temperature'.

Thirty papers under Section A and seven under Section B, were communicated for the Scientific meeting.

A visit was arranged on the 13th instant to the Tobacco Factory, Cleveland Town. The visitors were shown round by the management, and the several processes from the tobacco to the finished product ready for the market, were explained.

The following scientists have been elected Honorary Fellows of the Academy.

(1) Prof. Max Born; (2) Sir Henry Dale; (3) Dr. Irving Langmuir; (4) Prof. P. Niggli; (5) Prof. R. W. Wood.

British Association.—The Annual Meeting of the British Association will be held next year in Nottingham on September 1–8 under the presidency of Sir Edward Poulton. The following sectional presidents have been appointed.—Section A (Mathematical and Physical Sciences), Dr. G. W. C. Kaye; B (Chemistry), Dr. F. L. Pyman; C (Geology), Prof. L. J. Wills; D (Zoology), Prof. F. A. E. Crew; E (Geography), Prof. C. B. Fawcett; F (Economics), Prof. P. Sargant Florence; G (Engineering), Sir Alexander Gibb; H (Anthropology), Dr. J. H. Hutton; I (Physiology), Dr. E. P. Poulton; J (Psychology), Dr. Mary Collins; K (Botany), Prof. E. J. Salisbury; L (Education), Mr. H. G. Wells; M (Agriculture), Mr. J. M. Caie.—*Nature*, **138**, No. 3502, 1004.

* * *

The Effect of Annealing Procedure on the Tensile Properties of Arsenical Copper Bar. By F. F. G. Gilmore.—(*Bulletins of Indian Industrial Research*, 1936, No. 3).—This paper gives the results obtained in a series of tests carried out with a view to ascertain the effects of (*a*) annealing temperature and conditions, (*b*) period of annealing under constant conditions, (*c*) size of test pieces, upon the tensile properties.

A short description is given of the construction of the annealing furnace through which either steam or nitrogen could be passed continuously. The preparation of the test pieces and their characteristics are also described.

It was found that constant conditions of annealing were obtained by heating for not less than 60 minutes at 750° and for 120 minutes at 650°. Longer periods of annealing had no effect on the process. Further, the properties of the specimens annealed at the lower temperature were more satisfactory. No differences in the tenslie stress were observed in the experiments employing steam or nitrogen, but the specimens heated in steam remained comparatively bright while those heated in nitrogen were tarnished a dull brown. The steam method is therefore recommended for general practice. K. R. K.

* * *

Report of the Forest Products Research Board for the year 1935. (His Majesty's Stationery Office. Price 2*s*.)—The work described includes investigations on the physical, seasoning and fire-resistant properties and the working qualities of timbers, both home-grown and

imported, as well as on their chemical composition, durability and preservative treatment. The value of the work can be gauged by the increasing use made of it by industry, which is also described in the *Report*. The *Report* cannot fail to be of interest to all those concerned in any form with timber.

* * *

Lightweight Concrete Aggregates.—(His Majesty's Stationery Office. Price 4*d.*)—There is a considerable demand for lightweight concrete aggregates in building. This Bulletin describes the various materials—pumice, furnace clinker, coke breeze, lightweight slag, expanded clays, shales and slate—that are at present available for this purpose. The properties of the concretes made with these aggregates are indicated, and recommendations are given with regard to special points to be considered in specifying concrete mixes of lightweight aggregates for various uses.

* * *

Corrosion of the Tin-Plate Container by Food Products.—(His Majesty's Stationery Office. Price 1*s.*)—The corrosion of the tin-plate container by food products is still the basic problem of the canning industry.

Considerable practical progress has been made since 1931, and it now seems likely that the problem will eventually be solved by the improvement of lacquers and methods of lacquering; but this is not yet certain. It is therefore hoped that this second report, which describes experiments that throw further light on the factors involved in the corrosion of tin-plate and discusses the application of the results in commercial practice, will be of assistance to the industry. It is also hoped that it may be of interest to those who are concerned with the wider problem of corrosion in general.

* * *

Under the auspices of the National Geographic Society and the Smithsonian Institution, an expedition bound for the Jungles of Sumatra, has been organised to " bring back alive " wild animals of the "*Far East*" and to collect geographic and natural history information and photographs. The animals brought back will go to enrich the collection in Washington's famous Zoo. Dr. William M. Mann, Director of the National Zoological Park, will lead the expedition.

Accompanying Dr. Mann will be Mrs. Mann; a member of the National Geographic Society's photographic staff, and Roy Jenier and Malcolm Davis of the Zoo staff. The party will sail from Seattle, and after brief pauses in Japan, the Philippines and Singapore, will establish headquarters at some place on the Netherlands island of Sumatra, near the sea and in easy reach of "wild country". In the expedition's baggage will be a number of special " mercy traps " and a few special cases in which to carry small, delicate creatures. The heavy traps and cages needed for the larger jungle beast will be built in the field.

The region to be visited is at present only poorly represented by animals in the National Zoological Park. Dr. Mann feels, he will confer with game officials and naturalists in the countries to be visited, and will collect whatever he can of the missing specimens. Mammals, reptiles, birds, and a few fishes will be the primary objects of the collectors, but in spare time, Dr. Mann hopes also to collect insects and even a few botanical specimens.

After the work is completed in Sumatra, the expedition expects to visit the Netherlands island of Ceram, almost 2,000 miles to the east, and possibly some of the East Indies islands not under Netherlands Jurisdiction. Before starting home, the party will also visit Bangkok, Siam.

* * *

Announcements.

Journal of the Bombay Natural History Society.—The Honorary Secretary announces that with effect from 1st January 1937, a uniform rate of Rs. 5 per copy has been fixed for all back numbers of the Journal from Vol. I to Vol. 35 inclusive. Intending purchasers may apply to the Honorary Secretary, Bombay Natural History Society, 6, Appollo Street, Bombay (India).

* * *

Under the chairmanship of Gustave Fassin, of the Bausch and Lomb Scientific Bureau, Rochester, New York, a committee has been appointed to secure and arrange exhibits for the first **International Exhibition of Applied and Scientific Photography** ever held in the United States.

According to plans revealed by Mr. Fassin and Rowland S. Potter, National Chairman of the Scientific and Technical Section of the *Photographic Society of America* and President of the local section of the Society, which is sponsoring the exhibition, the exhibition will be held in the Rundell Memorial Building at Rochester, New York, in March 1937. This new and beautiful civic building has exceptional facilities for showing both pictures and apparatus.

Scientists all over the world are being contacted in an endeavour to make the exhibition fully representative of the many fields of applied and scientific photography. Scientists in any of the following fields are invited to send exhibits to the heads of the sections listed below, or to C. B. Neblette, Secretary of the Scientific Section at Rochester, who will supply entry blanks.

Dr. Walter Clark—Astronomy, meteorology, light sensitive substances.

Mr. Gustave Fassin—Photomicrography, microphotography, metallography.

Dr. Brian O'Brien and Dr. Walter Clark—X-Ray Spectrography.

Dr. T. R. Wilkins—Cosmic ray photography and theoretical physics.

Mr. C. B. Neblette—Press photography.

Mr. Glenn Matthews—High speed photography.

Mr. Rowland S. Potter and Mr. John W. McFarlane—Technique of color photography.

Mr. John W. McFarlane—Photography by invisible radiation.

Mr. Glenn Matthews—Aerial photography.

Secretary, C. B. NEBLETTE, F. R. P. S., *Rochester Athenæum and Mechanics Institute, Rochester, New York.*

We acknowledge with thanks receipt of the following :—

"The Agricultural Gazette of New South Wales," Vol. XLVII, No. 12, December 1936.

"Indian Journal of Agricultural Science," Vol. VI, Part V, October 1936.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 27, No. 10, October 1936.

"Journal of Agriculture and Livestock in India," Vol. VI, Part VI, November 1936.

"The Philippine Agriculturist," Vol. XXV, No. 7, December 1936.

"Journal of the Royal Society of Arts," Vol. LXXXIV, Nos. 4383–4388.

"The Calcutta Review," Vol. 61, No. 3, December 1936.

"Chemical Age," Vol. 35, Nos. 908–912.

"Journal of Chemical Physics," Vol. 4, No. 12, December 1936.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 69, No. 12,

"Russian Journal of General Chemistry," Vol. VI, No. 9.

"Journal de Chimie Physique," Vol. 33, No. 11.

"Experimental Station Record," Vol. 75, No. 5, November 1936.

"Transactions of the Faraday Society," Vol. XXXII, Part 12, December 1936.

"Indian Forester," Vol. LXIII, No. 1, January 1937.

"Indian Forest Records," Vol. II, No. 1, Entomology: A Survey of the Damage to Teak Timber by the Beehole Borer, throughout the Main Teak-bearing Forests of Burma.

"Forschungen und Fortschritte," Vol. 12, Nos. 34, 35/36.

Government of India Publications :—

- "Monthly statistics of production of certain selected industries of India" (Department of Commercial Intelligence and Statistics). No. 6, September 1936.
- "The New Statistical Tables Based upon Fisher's t." By M. Vaidyanathan, Bulletin No. 13.
- "Indian Trade Journal," Vol. CXXXIII, Nos. 1590–1594.
- "Annual Report of the Public Health Commissioner for 1934," with the Government of India Vol. I.

"Marriage Hygiene," Vol. III, No. 2, November 1936.

"Scripta Mathematica," Vol. IV, No. 2, April 1936.

"Journal of the Indian Mathematical Society," Vol. II, No. 4, 1936.

"The Calcutta Medical Journal," Vol. 31, No. 6, December 1936.

"Medico-Surgical Suggestions," Vol. 5, No. 12, December 1936.

"Review of Applied Mycology," Vol. 15, No. 11, November 1936.

"Carnegie Institution of Washington, News Service Bulletin," Vol. IV, No. 9.

"Report of the Fuel Research Board for the year ended 31st March 1936."

"Annual Report on the Working of the Tea Districts Emigrant Labour Act (XXII of 1932) for the year ending 30th September 1935."

"Agriculture and Animal Husbandry in India", 1933–34 and 1934–35, Part I, 'Crop Production.'

"Zoologisch Botanischen Gesellschaft in Wien", Bands—LXXIII, LXXIV/LXXV, LXXVI, Hefts 1–4, LXXVII, Hefts 1–4, LXXVIII, Hefts 1–4, LXXIX, Hefts 1–4, LXXX, Hefts 3–4, LXXXI, Hefts 1–4, LXXXII, Hefts 1–4, LXXXIII, Hefts 1–4, LXXXIV, Hefts 1–4.

"Journal of the Bombay Natural History Society," Vol. 39, No. 1.

"Nature," Vol. 138, Nos. 3499–3503.

"Journal of Nutrition," Vol. 12, No. 5, November 1936.

"Canadian Journal of Research," Vol. 14, Nos. 10 and 11.

"Science and Culture," Vol. II, Nos. 6 and 7.

"Lingnan Science Journal," Vol. 15, No. 4, November 1936.

"Scientific American," Vol. 155, No. 6; Vol. 156, No. 1.

Catalogues:

"Monthly list of books on Natural History and Science," December 1936. (Messrs. Wheldon and Wesley, Ltd., London.)

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences:

December 1936. SECTION A.—M. BORN AND N. S. N. NATH : *The Neutrino Theory of Light.—II.* CH. V. JOGA RAO : *An Optical Investigation of Some Indian Oils. III.—Intensity of the Scattered Light.*—The light scattered by the the oils has a a genuine molecular origin, and is subject to the usual laws of molecular scattering in dense media. H. GUPTA : *On a Conjecture of Ramanujan.* P. SURYAPRAKASA RAO AND T. R. SESHADRI : *Reactivity of the Double Bonds in Coumarins and Related α-β Unsaturated Carbonyl Compounds. Part III.—Action of Mercuric Acetate on Coumarinic and Coumaric Acids and Esters.* M. K. PARANJPE : *The Convection and Variation of Temperature near to a Hot Surface. Part II. Applications of Interferometry to the Measurements of Temperatures and Temperature Gradients Very close to a Hot Surface.*—Details of method and various precautions to be taken are discussed. S. CHOWLA : *On a Relation between Two Conjectures of the Theory of Numbers.* I. CHOWLA : *The Number of Solutions of a Congruence in Two Variables.* S. RAMA SWAMY : *The Structure of Thin Metallic Films.*—The structures have been studied by electron diffraction, and evidence has been obtained for the existence of gold and silver in the amorphous state. R. S. KRISHNAN : *X-Ray Diffraction and Electrolytic Dissociation.—Sulphuric Acid and Sulphates.* The change in the character of the halo with progressive dilution of pure sulphuric acid is followed. B. Y. OKE : *Lattice-Theory of Alkaline Earth Carbonates. Part IV.—Elasticity Constants of Calcite.* K. L. RAMASWAMY : *Refractive Indices and Dispersions of Gases and Vapours. Substituted Methanes and Ethane, Cyclopropane, Ethylene Oxide, and Benzene.* M. A. GOVINDA RAU : *The Dipole Moment and Structure of Pyrones.*—2.6 *Dimethyl-*

γ-*Pyrone, Xanthone, and Coumarin.* The observed moments are explained on the basis of the various excited and unexcited states in resonance.

December 1936. SECTION B.—L. A. KRISHNA IYER: *The Primitive Culture of Travancore.* M. A. H. QADRI: *Male Genitalia of Mallophaga Infesting North-Indian Birds.*—The Male Genitalia of some of the important forms belonging to Amblycera and Ischnocera have been described. PRAKASH CHANDRA JOSHI: *Some Phases of the Life-History of Two Tibetan Caryophyllaceæ*—Arenaria musciformis *Wall and* Thylacospermum rupifragum *Schrenk.*—The available stages in the development of the male and female gametophytes of the two plants and the structure of the seed of the latter have been described. BENI CHARAN MAHENDRA: *A Case of Polymely in the Indian Bull-Frog* Rana tigrina *Daud.*—A complete description of the external features of the specimen has been provided together with an account of the correlated abnormalities in the muscular, skeletal and nervous systems. L. A. KRISHNA IYER: *Anthropometry of the Primitive Tribes of Travancore.*—Additional evidence is provided for the existence of a Negrito strain in the aboriginal population of South India.

The National Academy of Sciences, India:

December 21, 1936.—R. N. GHOSH: *On a Simple Derivation of Stresses in a Moving Fluid.* L. S. MATHUR: *Infra-red Absorption Spectrum of Tin-di-iodide.* L. S. MATHUR: *Determination of Latent Heats of Vapourisation of the Selenides of Cadmium and Mercury and Telluride of Zinc from the Absorption Spectra of Their Vapours.* B. N. SINGH: *The Prevention of Rots in Tomatoes with Especial Reference to the Mould's Attack.*

Calcutta Mathematical Society:

December 20, 1936.—N. N. GHOSH: *A Note on the Solution of a System of Linear Equations.* S. GHOSH: *On Some Two-Dimensional Problems of Elasticity.* M. DE DUFFAHEL: *Sur Certains Systemes d'Equations dux Differences Totales.* M. DE DUFFAHEL: *Sur la Generalisation du Probleme de Dirichlet et sa Solubilite.*

Meteorological Office Colloquium, Poona:

November 3, 1936.—Dr. K. J. Kabraji.—"The condensation of water in the atmosphere" [based on Bennett's paper on the subject (*Q. J. Roy. Met. Soc.*, 1934) and on cognate researches of H. Kohler].

November 10, 1936. Dr. L. A. Ramdas.—"Some problems of solar and atmospheric radiation."

November 24, 1936. Dr. S. K. Pramanik.—"Bergeron's paper on the physics of cloud and precipitation."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Benares Hindu University:

Annual Meeting of the Court.—

At the Annual Meeting of the Court held last month the following office-bearers were elected :—

Chancellor: Major-General His Highness Maharajadhiraj Raj-Rajeshwar Narendra-Shiromani Maharaja Shri Sir Ganga Singhji Bahadur, G.C.S.I., G.C.I.E., G.C.V.O., G.B.E., K.C.B., LL.D., A.D.C., Maharaja of Bikaner. *Pro-Chancellors:* (1) Major His Highness Raj-Rajeshwar Sir Umed Singh Bahadur, G.C.I.E., K.C.S.I., K.C.V.O., Maharaja of Jodhpur. (2) His Highness Maharaja Sir Aditya Narain Singh, K.C.S.I., Maharaja of Benares. *Pro-Vice-Chancellor:* Raja Jwala Prasad, B.A., C.E., M.I.E. (India). *Treasurer:* Rai Govind Chand, M.A., M.L.C.

Faculties.—

At the Annual Meeting of the Faculties the following Deans were elected :—

Faculty of Arts: Prof. Gurmukh N. Singh, M.Sc. (London), Bar-at-Law. *Faculty of Science:* Prof. P. K. Dutt, M.A. (Cantab.). *Faculty of Technology:* Dr. N. N. Godbole, B.Sc., M.A., Ph.D. (Berlin). *Faculty of Law:* The Rt. Hon'ble Dr. Sir Tej Bahadur Sapru, Kt., P.C., LL.D. *Faculty of Oriental Learning:* Mahamahopadhyaya Pandit Pramathnath Tarkbhushan. *Faculty of Ayurveda:* Mahamahopadhyaya Kaviraj Dr. Gananath Sen, M.A., M.D., L.M.S. *Faculty of Theology:* Pandit Vidyadhar Gour.

Research.—

Pandit Raj Bali Pandey, M.A., a research scholar, submitted a thesis on *the Origin, Significance and History of Hindu Sanskaras* which was sent for valuation to three external examiners—Prof. A. B. Keith, Dr. Ganganath Jha and Mr. P. V. Kane. The reports of the examiners being unanimously favourable, the Faculty of Arts recommended to the Senate that the Degree of Doctor of Letters be conferred on Pandit Raj Bali Pandey.

The University has vigorously pursued the policy of undertaking research work related to the industrial needs of the country. Out of nine prizes awarded by the Industrial Research Council of the Government of India the University secured three prizes—the second, the third and the fifth. The second prize was awarded to Dr. V. S. Dubey, D.Sc. (London), and Prof. M. B. Rane, M.A., for working out a process for the manufacture of sulphuric acid from Gypsum. The third prize was won by Dr. V. S. Dubey and Mr. P. N. Agrawal, M.Sc., for their work on the substitution of soda ash by an Indian rock in glass manufacture. The fifth prize was awarded to Mr. Sadgopal, M.Sc., for his valuable work on the aromatic resources of India.

University of Mysore:

1. *Examinations.*—

The Pre-Medical, (I) M.B.B.S. and (II) M.B.B.S. examinations were held in December 1936.

2. *Extension Lectures.*—

The following extension lectures in Kannada were delivered :—

(*a*) Mr. H. K. Ramiengar, M.A., Assistant Director of Industries and Commerce, Bangalore, on "Village or Rural Industries", at Nanjangud.

(*b*) Dr. K. N. Venkatasubba Sastry, M.A., Ph.D., F.R.Hist.S., Assistant Professor, Maharaja's College, Mysore, on "The History of Mysore Administration", at Tumkur and Kolar.

3. *Deputation to congresses and conferences.*—

Mr. E. G. McAlpine, M.A., Dip.Edn., V.D., J.P., Principal, Central College, Bangalore, presided over the Annual Conference of the Mysore State Education League held in December 1936, at Chikmagalur.

Mr. A. R. Wadia, B.A., Bar-at-Law, Professor of Philosophy, Maharaja's College, Mysore, also attended the Conference.

Dr. M. H. Krishna, M.A., D.Litt., Professor of History, Maharaja's College and Director of Archæological Researches in Mysore, presided over the Historical Conference and Mr. B. M. Srikantia, M.A., B.L., Professor of English, Central College, Bangalore, presided over the Literary Conference held at Hampi in December 1936, in connection with the Vijayanagar sexcentenary celebrations.

The following other members of the teaching staff of the University were deputed to attend the conferences and congresses as noted :—

(*i*) Mr. K. B. Madhava, M.A., A.I.A., Professor of Mathematical Statistics and Economics, Maharaja's College, Mysore—The Twentieth Annual Conference of the Indian Economic Association, Agra.

(*ii*) Mr. L. Rama Rao, M.A., F.G.S., Professor of Geology, Central College, Bangalore—The Indian Science Congress, Hyderabad.

(*iii*) Mr. B. R. Subba Rao, M.A., Lecturer, Intermediate College, Mysore—The Twentieth Annual Conference of the Indian Economic Association, Agra.

(*iv*) Mr. G. Hanumantha Rao, M.A., Lecturer, Maharaja's College, Mysore—The Indian Philosophical Congress, Delhi.

(*v*) Mr. N. S. Narayana Sastri, M.A., Lecturer, Maharaja's College, Mysore—The Indian Science Congress, Hyderabad.

4. *Recognition of Examinations (M.B.B.S.).*—

Intimation has been received from the Director of Examinations, Royal College of Surgeons in England, London, that candidates who are able to produce the schedule of certificates of study required for admission to the Primary F.R.C.S. examination completed and signed by the University of Mysore will be admissable to the Primary Examination for the Fellowship of the Royal College of Surgeons in England.

The Central Advisory Board of Education:

The problem of educational reconstruction and unemployment was again the main subject of deliberation before the Central Advisory Board of Education which met recently in Delhi, as it was at its first meeting held in December, 1935. According to a Press note issued by the Director of Public Information the Board had under consideration the recommendations made by the Unemployment Committee, United Provinces, 1935. Certain recommendations of this Committee regarding University education, on which the Government of India also felt that it would be advantageous to obtain the views of the local Governments in order that they might be placed before the Board for consideration, related to—

(*a*) the raising of fees charged in Universities;

(*b*) the prescribing of limit to admission of students to Universities;

(*c*) the content of education as given in the Universities, *i.e.*, the need of greater stress on scientific and vocational education;

(*d*) the system of co-ordination between different Universities so as to secure uniformity of standards and prevent unhealthy competition;

(*e*) the setting up of an Advisory Grants Committee to advise the Ministry of Education in regard to the grants which are made to the Universities for research work; and

(*f*) the sending of students overseas for further education.

The entire subject was again considered by the Board, particularly in regard to unemployment amongst the educated classes and the importance of obtaining reliable statistics. After a general discussion the Board decided that the views of the Inter-University Board should first be obtained on the recommendations relating to University Education, and the matter be then discussed further by the Board.

It may be remembered that when last year the Board had before it for consideration the problem of educational reconstruction and unemployment, it passed a series of resolutions, suggesting a radical reform of the system of secondary education, so that apart from providing instruction which would lead to Universities and to professional colleges, the system might have stages at the end of which students could branch off either to private occupations or to vocational schools. As it was of vital importance that such a scheme should be well devised and should afford an effective substitute for a purely literary type of education, the Board had stated that expert advice would be of value in organizing a scheme of reconstruction. This suggestion of the Board was accepted by the Government of India. After consulting the local Governments the Government of India were able to obtain the services, during this cold weather, of two experts—Mr. Abbott, late Chief Inspector of Technical Schools, Board of Education, London, and Mr. Wood, Director of Intelligence, Board of Education and Ministry of Health, London. Unfortunately, because of the shortness of time, it was not possible for the Government of India to obtain an adequate number of experts for a simultaneous survey of educational problems throughout India. Within the time allotted, Messrs. Abbott and Wood will probably only be able to make detailed recommendations in regard to the Provinces of Delhi, the Punjab and the United Provinces. If they have time they may be able to visit Bengal and Bombay also.

ERRATUM.

Vol. V, No. 6, December 1936, Page 295.
Note entitled "On the Constitution of Ayapin".—1st line
for "ayapin" *read* "ayapanin".

1943-36.—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.